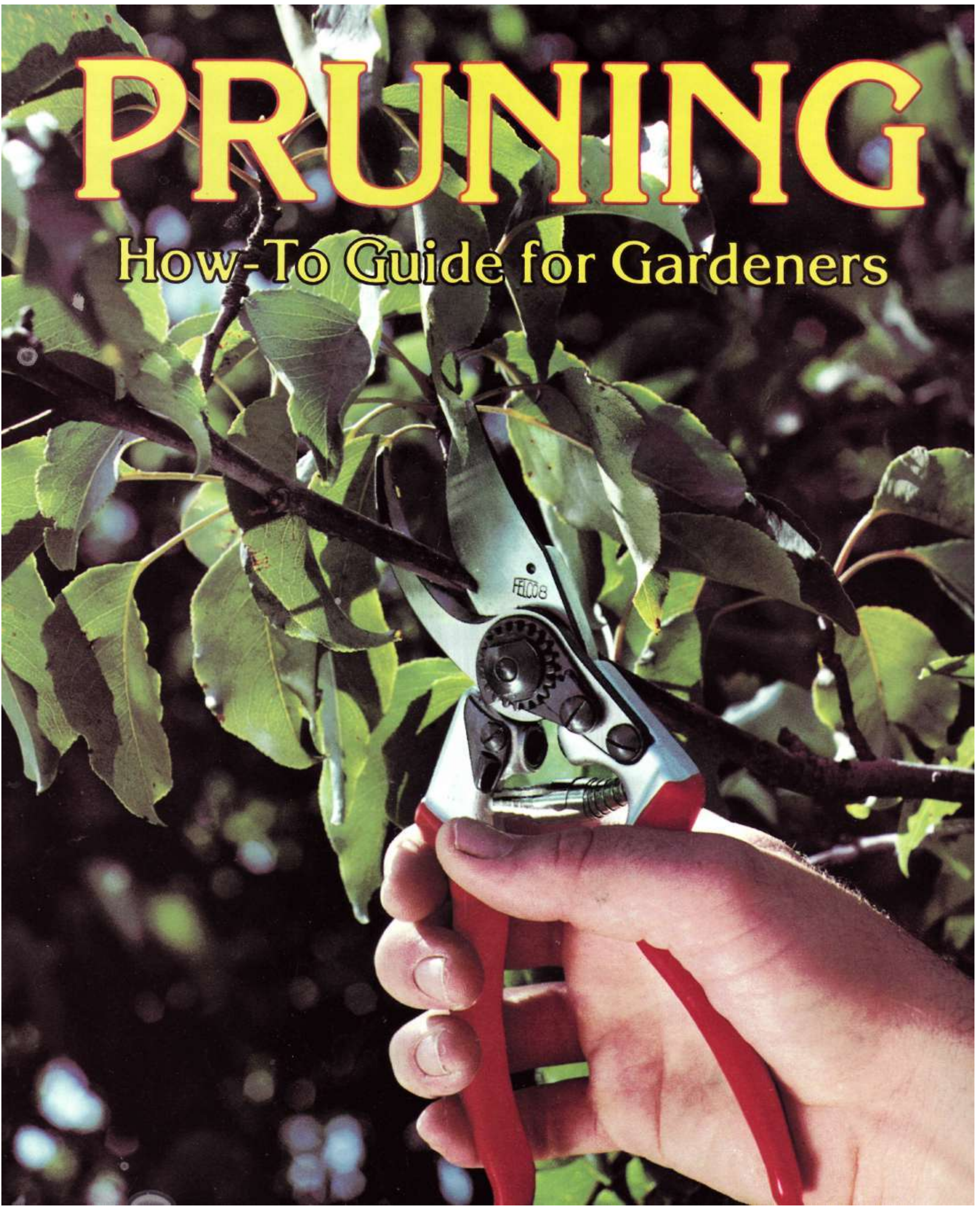
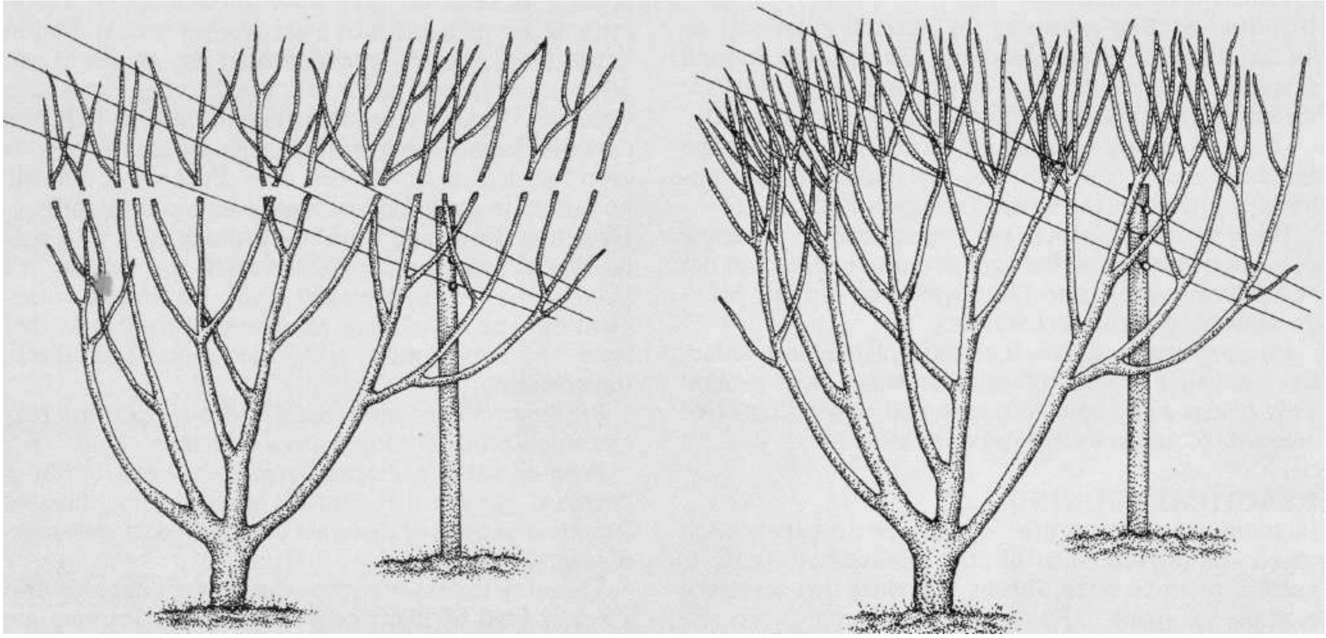
PRUNING

How-To Guide for Gardeners



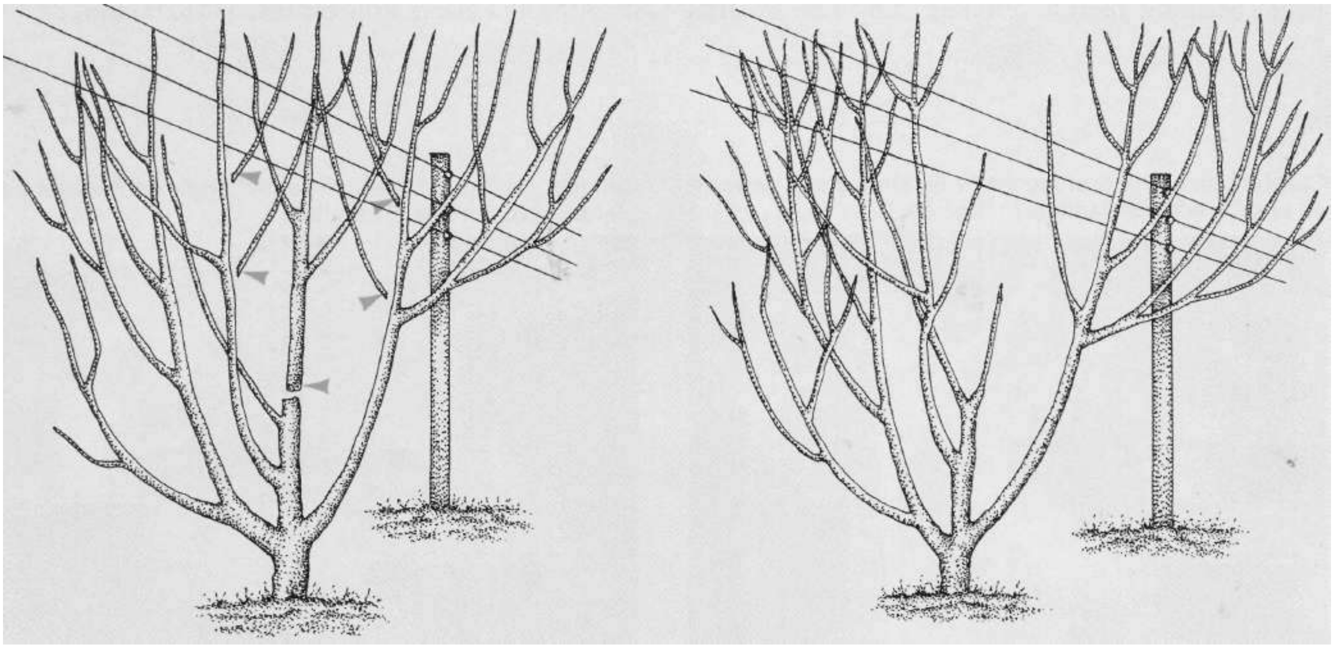
PRUNING FOR CONTAINMENT



HEADING

Trees are pruned to provide clearance for overhead utility lines. Heading, the removal of all the branches at one level, promotes dense regrowth.

Regrovi/th after heading results in a tangle of branches even harder to control and can seriously damage overhead utility lines.



THINNING

Careful selective thinning of uppermost branches creates an easily maintained opening for utility lines.

Regrowth after thinning is controlled and directed away from lines, preventing damage to lines and tree.

Influences on Plant Growth

From the day any plant begins life as a seedling, its growth is influenced by climatic and biological conditions. Climates vary considerably over large and small geographic regions. Differences in climates are determined by amounts of rainfall, sunshine, mountain ranges, longitude and latitude, elevations and bodies of water.

The ability of plants to grow and survive in any particular climate is called *hardiness*. Growth of all plants is influenced by the following conditions:

- Sunlight, Day Length and Temperature.
- Air, Wind, Soil and Water.
- Wildlife and Diseases.
- Genetic Heritage.

Scientists have been studying these influences for centuries. In many cases, their effect on the way some plants function is still not completely understood. Fortunately, the gardener only needs to understand a few basic facts about how plants grow and the influences that affect them.

Sunlight and Day Length—All plants are *phototropic*. This means they respond to light in a positive way. Shrubs, trees and vines all grow toward light.

Sunlight, or solar energy, is essential for plants to live. Leaves are solar collectors. Leaves orient themselves towards the sun. Through a process known as *photosynthesis*, leaves manufacture food for the tree. Photosynthesis converts energy from the sun into starches and sugars, or food. This food is a basic sugar. When leaves don't receive enough sunlight to manufacture food, they drop from the plant.

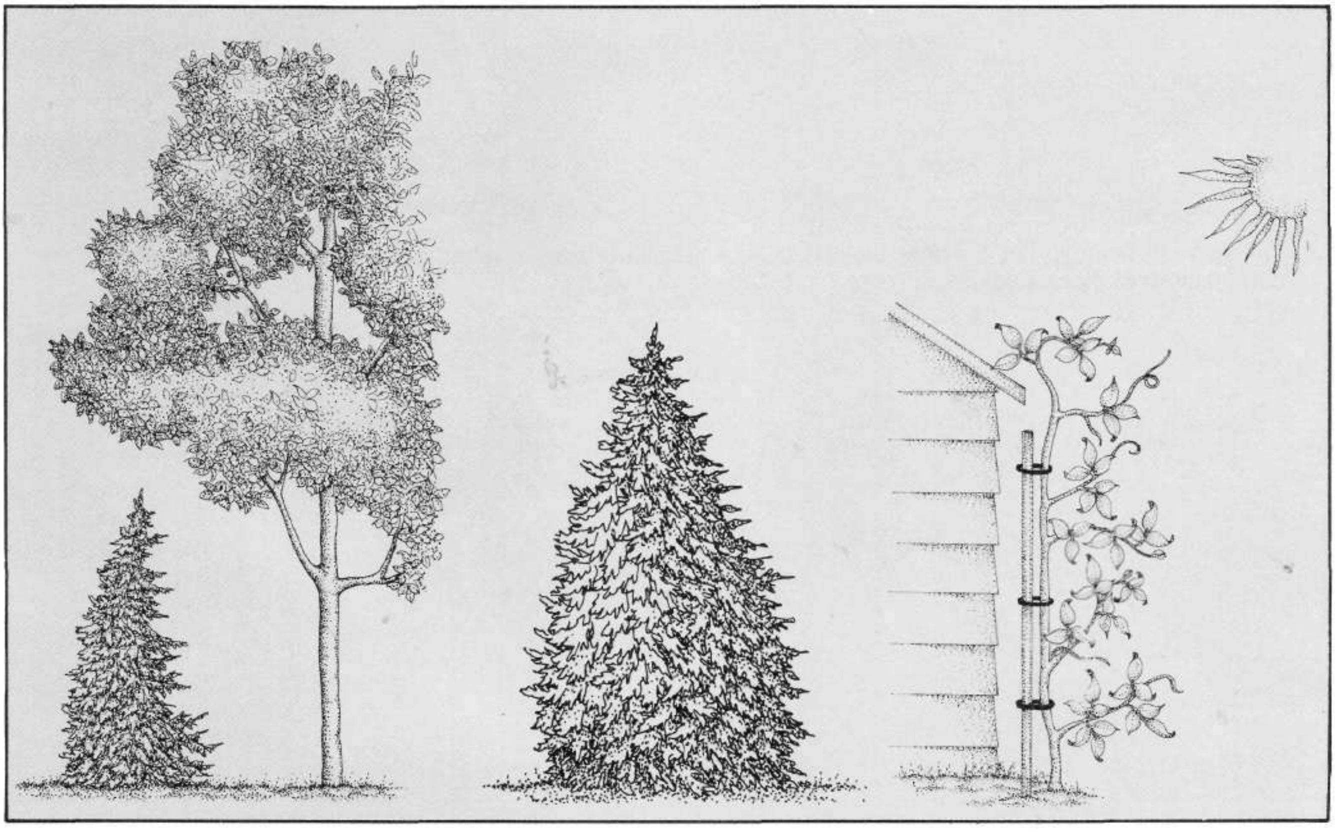
Shaded areas of plants tend to become bare of foliage. Shaded parts may fail to bloom, or if they bloom, only a few blooms will set fruit. Pruning helps trees or shrubs arrange foliage to intercept the sunlight.

Day Length, or more correctly the length of night, is the determining factor that tells *deciduous perennial plants* when to develop flowers or drop leaves. Deciduous plants lose all their leaves each year. Perennial plants live from year to year. Studies have produced little knowledge about how day length initiates flowering or leaf-drop. *Evergreen* tropical and subtropical plants are not affected by day length. Evergreen plants don't lose all their leaves each year.

Temperature—Daily and seasonal temperatures have a pronounced effect on plants. Each climate differs in amount and intensity of sunlight, temperature extremes and many other variables. All the factors above have various effects on plants depending upon the season of the year.

Day length and temperature initiate a series of physical and chemical changes in plants each year. These changes are called *acclimation*. The acclimation process helps plants acquire resistance to cold. Acclimation enables plants to survive winter months.

The initial phases of acclimation are started by decreasing day length. Latter phases of acclimation depend on the occurrence of colder temperatures.



Left: The side of a tree that faces a larger tree is dwarfed because the smaller tree is shaded from the sunlight. Center: A tree growing in an open field is more symmetrical because light evenly illuminates all sides. Right: Leaves on plants will always orient themselves toward the dominant light source.

Pruning in late summer can delay acclimation by plants and result in winter-damaged trees and shrubs.

Air and Wind—Atmospheric quality and wind movement have a significant effect on plant growth. If air quality is poor or contains large amounts of pollutants, trees and shrubs may suffer.

Movement of trees by wind stimulates trunks of woody trees to become thicker and more resistant to movement. Constant wind along coastlines produces trees and shrubs that lean away from the wind.

Soil and Water—Water has a profound effect on all plants. Periods of drought can cause trees to lose leaves. The sun can burn exposed limbs and trees can die. Pruning of selected limbs can reduce water requirements. Leaf loss and pruning enables plants to survive periods of drought.

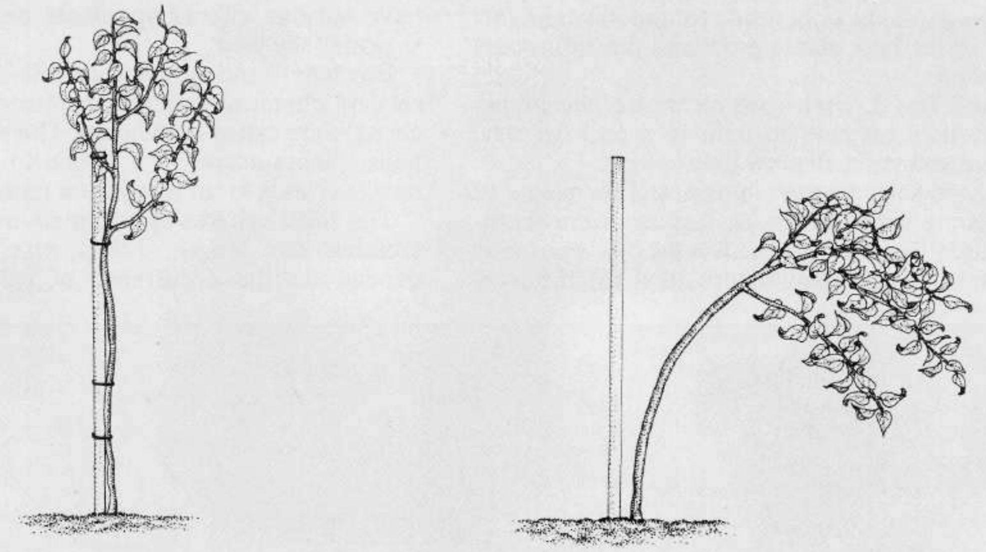
Soil condition is an important influence on plant growth. The texture of the soil can allow roots to grow easily or work harder to anchor plants. Soil quality, or existence of organic matter, nutrients and moisture, is important to trees, shrubs and other plants.

Wildlife and Diseases—Insects, birds and animals are a natural part of a tree's environment. Normal activities of these creatures can both help and damage trees.

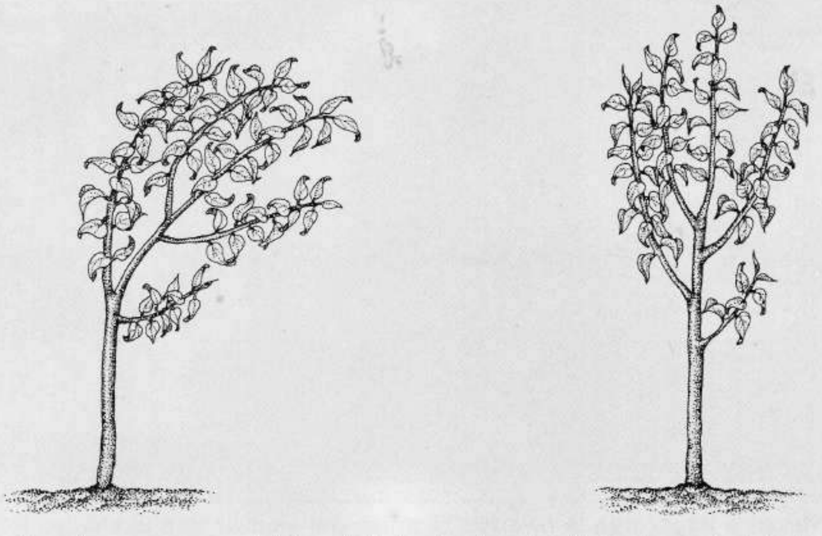
Insects or decay fungi may enter wounds caused by deer rubbing against tree trunks. Insects will eat the inside of the tree. Birds, searching for a meal, may eat the insects. Decay fungi can spread inside trees. Decay weakens trees and may leave small cavities. Cavities can provide a nesting place for birds or animals.

Pruning broken branches and repairing damaged bark can prevent entrance of insects or disease. Removing infested parts of trees can prevent spread of insects or disease. Filling cavities closes entrance points for animals and insects.

Genetic Heritage—Every species and variety of plant responds to the environment according to genetic heritage.



Young trees immobilized by tight staking do not develop strong trunks. When untied from the stake, they cannot support themselves.



If trees are allowed some movement in wind, trunks develop their characteristic taper and produce reactive wood for necessary strength.

This genetic commitment of plants tells them to do many different things. For pruning purposes, genetic programming tells plants to do the following:

- Produce wood for trunks and large limbs.
- Produce and extend shoots with little wood.
- Develop flowers and fruits.

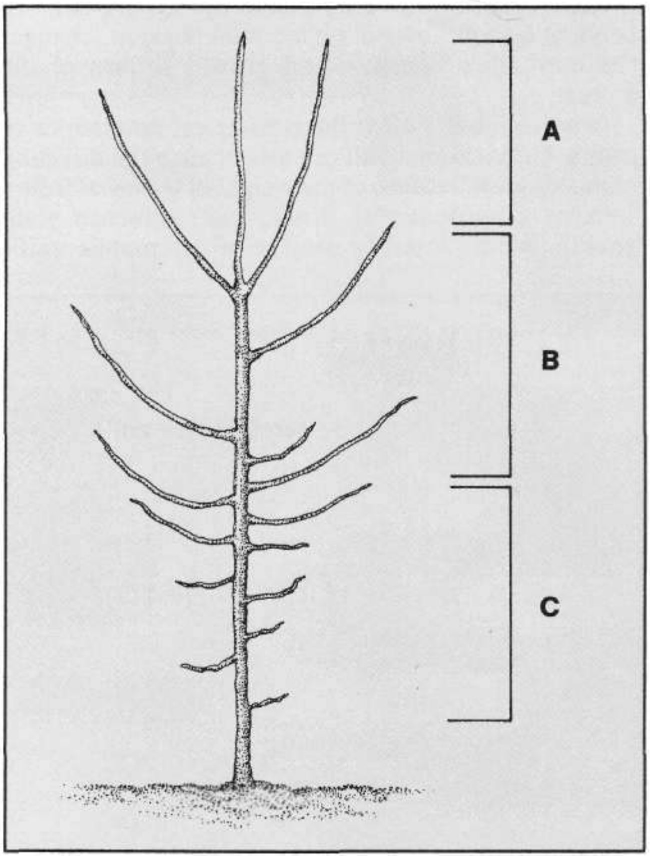
All these commitments can influence plants during different stages of growth. Young trees normally produce lots of wood and shoots. After two or three years, they begin to produce more flowers and small amounts of fruit, while still producing wood. As trees mature, they consistently produce fruit, with little growth of trunk or limbs.

Pruning can sometimes change genetic commitments, but it almost never eliminates these commitments completely.

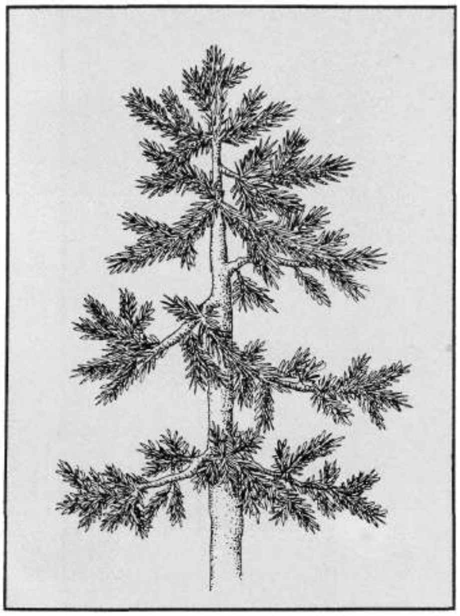
Growth Habit of a tree refers to the shape in which the tree grows. A tree may grow low to the ground with wide, spreading branches. A tree may be tall and stiff, flexible and willowy, or even weeping. Shape is determined by genetic code.

Growing patterns are controlled to a large extent by the growing shoot tip or leader of plants. The growing shoot tip is sometimes called the *terminal ox apical bud*. The growing shoot tip plays an important role in the growth of parts of the plant below the tip. In this phenomenon, called *apical dominance*, the growing shoot tip produces a *hormone*, called *auxin*. Auxin is a growth hormone that moves through the tree down toward the earth. Auxin tells shoots to grow up and roots to grow down.

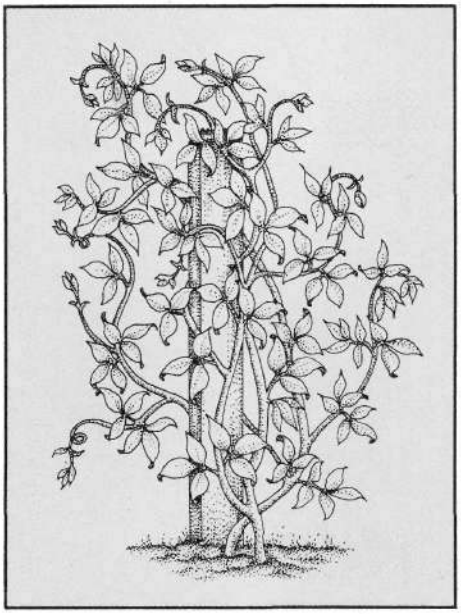
In a way not completely understood by scientists, auxin inhibits or slows growth of most buds formed in *axils* of leaves on the same shoot. The axil is the upper angle formed by a leaf and the branch. Auxin also causes lower shoots to form at wide angles with the main stem or trunk.



Apical dominance refers to the influence exerted by growing shoot tips on buds and the shoots below them. The hormone that originates in the tips of shoots, section A, migrates toward the ground. The hormone causes shoots in section B to form wide angles with the central axis. Growth of shoots in section C is also suppressed. Knowledge of apical dominance is basic to an understanding of pruning.



Genetic heritage commits some plants to production of wood.



Other plants are committed to the extension of stems with little wood.

Other plants produce more blossoms and seeds than wood and stems.

Removing the growing shoot tip by pruning, or bending a shoot toward a horizontal position, changes the hormone's response and growth pattern of the branch.

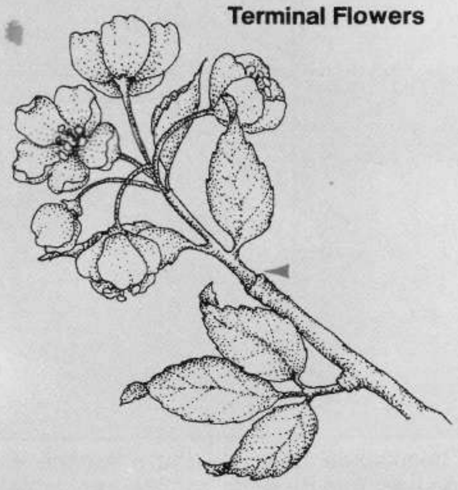
Gravitational Pull influences apical dominance in plants. Gravitational pull can also change the direction branches grow because of the weight of leaves or fruit.

Other environmental factors can influence plant growth. Wind caused by passage of automobile traffic can force trees to grow in a different direction. Foreign chemicals may be toxic to young plants, stunting growth.

Flowering Habit refers to age and position of wood that bears flowers. Flowers may appear on current season's growth of wood, on last season's growth or on long-lived spurs several years old. Flowers may also be born *terminally* at the end of growing wood, or *laterally* on the sides of growing wood.

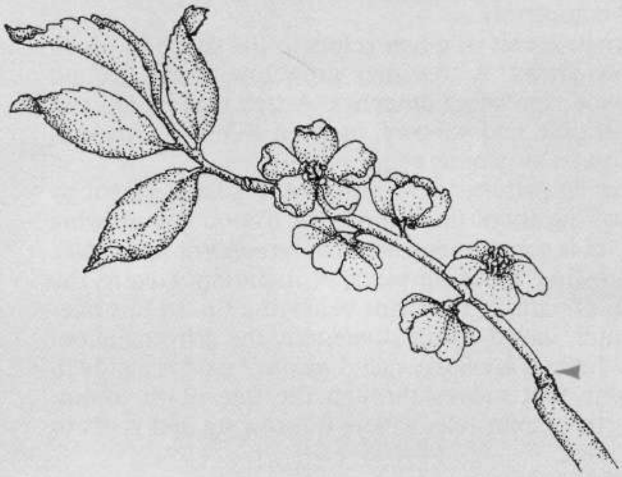
FLOWERING HABIT OF PLANTS

Terminal Flowers



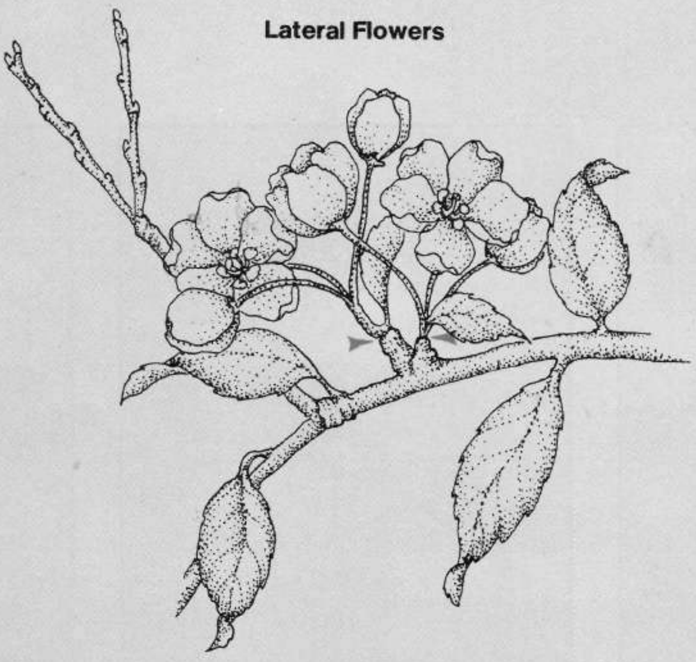
Some plants produce blooms only on current-season's wood. Crape myrtle is a good example.

Lateral Flowers



Others produce blooms on wood of the previous-season's growth. Lilac is a good example.

Lateral Flowers



Other plants produce blooms on older spurs. Apples are excellent examples.

Perennial Plants

For a better understanding of why and how to prune plants, it is important to know the name and function of each plant part. Refer to the illustration on page 14. This illustration provides the basis for information in this section.

PARTS AND FUNCTIONS

All plants contain the following parts:

- Roots
- Trunk or Stem
- Branches, Limbs and Twigs
- Leaves

Roots—They form the basic anchoring system for all plants. Roots hold plants firmly in place in the soil. Roots obtain all essential inorganic nutrients, minerals, and water from soil.

Roots accomplish their tasks through a complex system of *lateral* and *feeder roots.* Roots are covered with tiny *root hairs.* As roots grow, they force their way through soil in search of water and minerals. This strong network of growing roots helps anchor plants to the ground.

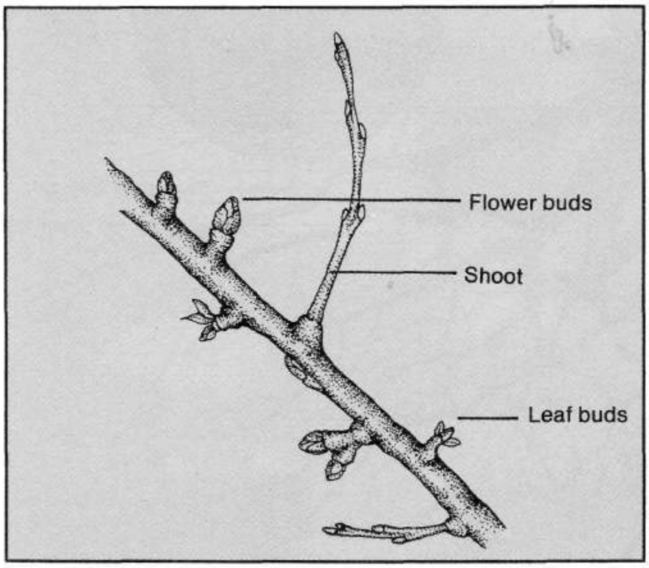
Trunk—The trunk or stem provides the main support system of the trees. The internal structure is composed of *xylem, phloem* and *cambium.* The xylem, phloem and cambium form a complex vascular system. This vascular system is made up of conducting cells. These cells transport water, minerals and food throughout trees.

Branches—There are two types of branches in trees: *scaffold* branches and *lateral* branches.

Scaffold branches are large, forming the basic shape of trees and providing support.

Lateral branches are smaller. They tend to fill in the outline of trees. Lateral branches support growing twigs, leaves and fruit.

Twigs—These small structures are commonly called the *growing shoots.* They contain the growing shoot tip or terminal bud. This is sometimes called the *apical bud.* Twigs contain many lateral buds along the side of the twig. Basic materials for development of the leaves and flowers are inside these buds.



Flower buds are easy to distinguish from leaf buds. Flower buds are rounder and plumper.

Buds—Buds are formed in axils of leaves during the growing season. Buds are covered by layers of protective scales. Basic *primordia,* or partially formed parts of leaves or flowers, are found under these layers of scales.

Buds may contain only leaf primordia, only flower primordia, or a combination of both leaf and flower primordia. Flower buds are usually larger and rounder than leaf buds.

The Flowering Habit of trees refers to age and position of twigs that contain flower buds. Buds may be positioned terminally at the end of twigs or laterally on the side of twigs. Buds can appear on current season's growth, last season's growth or on long-lived spurs.

Leaves—Food for plants is produced by leaves. Leaves are food factories. Leaves collect energy from the sun and change energy into starches and sugars —carbohydrates—for plants. During this food production process, called *photosynthesis,* leaves absorb carbon dioxide and release water and oxygen into the atmosphere.

INTERNAL STRUCTURE AND FUNCTION

It is important to remember that different parts of a tree are interconnected and dependent on each other.

Let's take a closer look at the internal structure of a typical plant and see how it actually works.

Xylem—The innermost part of a tree is called *xylem.* This inner cylinder of wood contains old heartwood and young sapwood. *Heartwood* is the non-living part of the tree. Heartwood provides structural support for the tree. *Sapwood* is the living part of the tree. Sapwood conducts water and mineral nutrients from the roots to all branches and leaves.

The young xylem, or sapwood, is interconnected throughout the tree. If you prune off a small limb, water going to that limb is sent to the remaining limbs. If you cut off a root from one side of a tree, roots from the tree's other side will supply the entire tree with water.

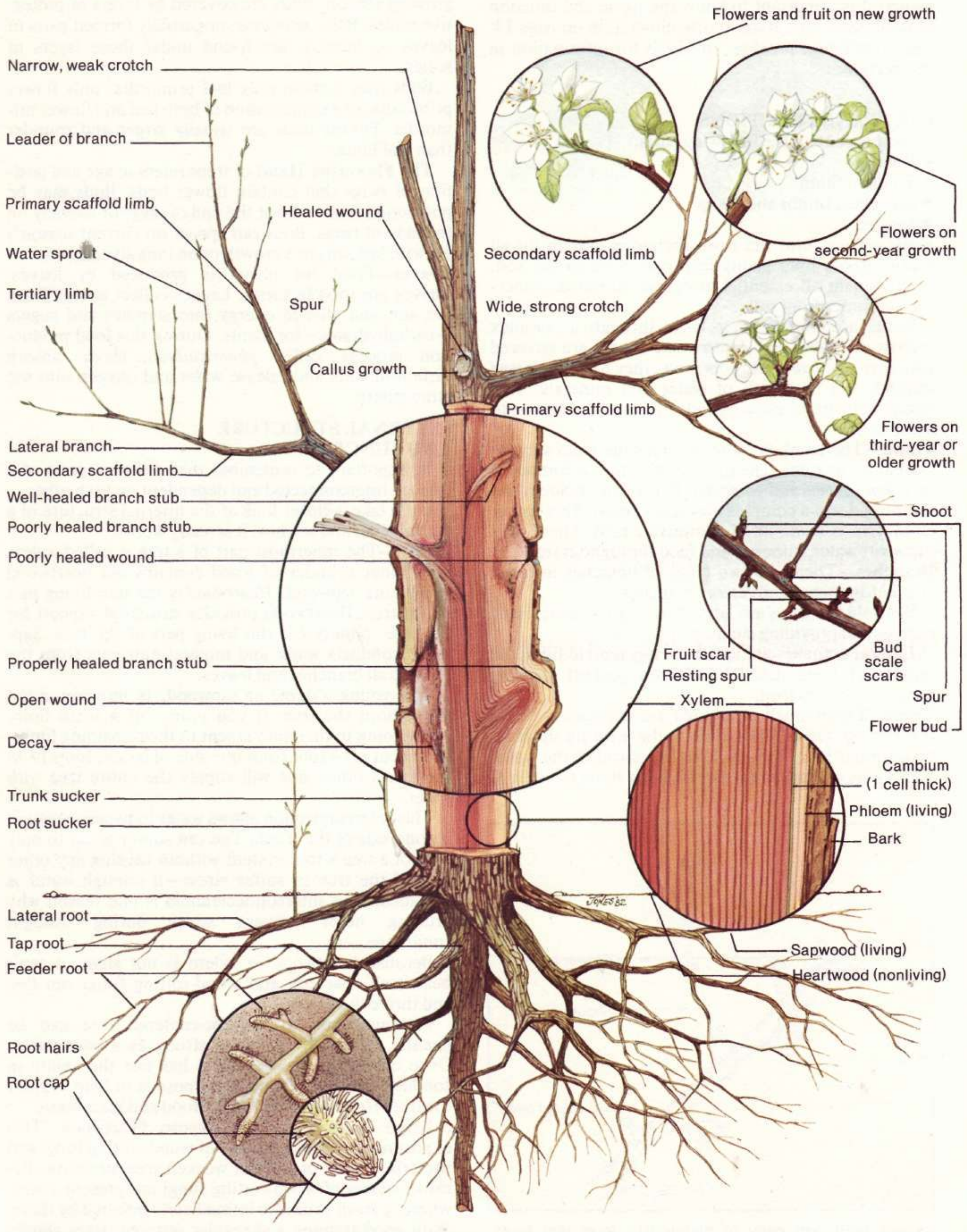
This interconnection allows water to bypass a wound on one side of the trunk. You can supply water to only 25% of a tree's root system without causing any other part of the tree to suffer stress—if enough water is provided. This interconnectedness is one reason why pruning helps prevent stress during drought conditions.

Because heartwood in xylem is not alive, it can't heal itself. Bacteria and wood-rotting fungi can live and thrive in heartwood.

Although an old, hollow-centered tree can be healthy, it usually is not as strong as a young tree. Once old xylem or heartwood has lost the ability to conduct nutrients, its main purpose is to help support the tree. Heartwood also stores food and plant waste.

Large pruning wounds expose heartwood. This exposure can allow entrance of wood-rotting fungi and bacteria. These organisms weaken tree structure. Because spores of wood-rotting fungi are present everywhere, a fresh wound is immediately infected by them. With good training and regular pruning, trees should not need large pruning cuts.

ANATOMY OF A TREE



Cambium—The cambium is the layer of wood between the xylem and the phloem or *inner bark.* Cambium is one cell thick. The cambium is a living part of the tree. The cambium produces new xylem cells on the inside and new phloem cells on the outside. Annual production of new cells by the cambium to form xylem and phloem increases the trunk diameter in plants.

Phloem—The phloem or inner bark is a living part of the tree. It is an important part of the vascular system. The phloem moves food to growing shoot tips and fruit. It also moves food into the starch-storage cells in the bark, xylem and growing roots.

Bark—The bark is the outer protective covering of the tree. Bark prevents the tree from drying out and protects the tree from attacks by insects and disease. If bark is damaged, it may give off large amounts of gum or resin. Resin production is the tree's way of trying to reject or kill intruders.

Bark contains *latent buds* that grow only enough to remain near the outer surface. If a large branch is broken or cut off, latent buds located below the wound will grow and form new branches.

All parts of trees or shrubs are interconnected and dependent on each other. If you remove a section of bark from around a grape vine, called *girdling,* sugars can't move down to the roots. Instead, the sugars move to the fruit, making the fruit larger and sweeter.

By limiting root growth, a heavy fruit crop can require more water. The need for more water increases drought stress. Heavy cropping or summer pruning competes with bark for sugars. Reserves of starch don't accumulate in xylem layers and the tree is devitalized during the next growing season.

Now that you have a basic understanding of how plants grow and develop, take a walk through your garden and observe the perennial plants. Can you see how they are responding to sunlight or wind?

Examine plants closely to see how genetic heritage influences growth and development. Look at growing shoot tips and find terminal buds. See if you can distinguish between flower buds and leaf buds. You should also look for evidence of old or new wounds, insect damage and broken limbs.

Plant Response to Pruning

How different plants respond to pruning depends on apical dominance, type of pruning cuts and growth habits of the plant.

APICAL DOMINANCE RELEASED

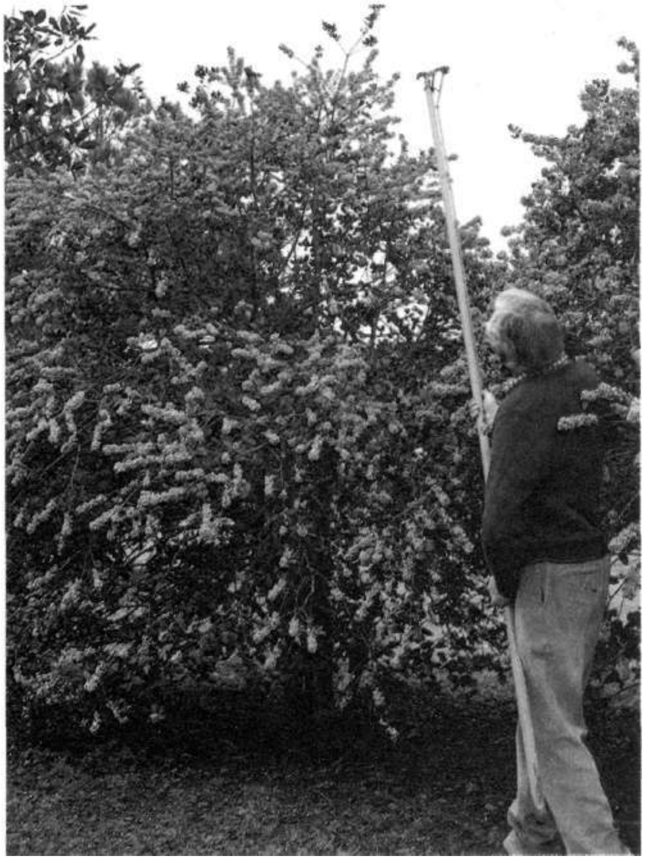
Whenever a plant is pruned, you interfere with the process of apical dominance in terminal buds. Pruning terminal buds removes the source of the lateral bud *inhibitor,* a chemical substance that slows or prevents growth. Pruning allows the topmost lateral buds to exert apical dominance over other lateral buds lower on the branch. The upper buds will grow faster than the lower buds, sending shoots upward, sometimes even overtaking and passing terminal buds. This can result in undesirable *water sprouts* on the upper side of branches. Water sprouts are vigorous, vertical shoots that are usually undesirable.

PLANT GROWTH STIMULATED

Pruning in any form stimulates new growth near cuts. Usually several lateral buds form new shoots, or water sprouts, just below pruning cuts. These new shoots result in considerable new growth. Rapid new growth occurs because top growth has been reduced in relation to the size of roots, trunk and main branches. The new growth receives water, minerals and other nutrients stored during the previous season.

Even with new growth, pruned plants always end up smaller. This is called the *dwarfing effect.* Dwarfing occurs because total amount of regrowth after pruning is not enough to replace the amount of plant material removed, plus the growth that would have grown from the original plant material.

Dwarfing is often one of the gardener's main objectives. The dwarfing effect allows gardeners to shape plants. A good example is the popular Japanese *bonsai* plants that are shaped by selective pruning. Bonsai is the art of dwarfing and shaping trees and shrubs.



Pole pruners are useful tor reaching the tops of trees. Here pole pruners are used to remove apical tips of branches to control the growth and size of this tree.

When to Prune

A favorite saying about pruning is, "Prune when the shears are sharp." Like most maxims, it oversimplifies and distorts a subject that can be quite complex.

The best time to prune varies with the type of plant, the time of year and the objective of pruning.

First decide what you want to achieve by pruning. Then you can decide when to prune a tree or shrub. The effect of pruning can be different depending on the time of year and the climate.

In general, use the following statements as a guide. For information on specific plants, consult the Encyclopedia section for details on results of pruning and when to prune.

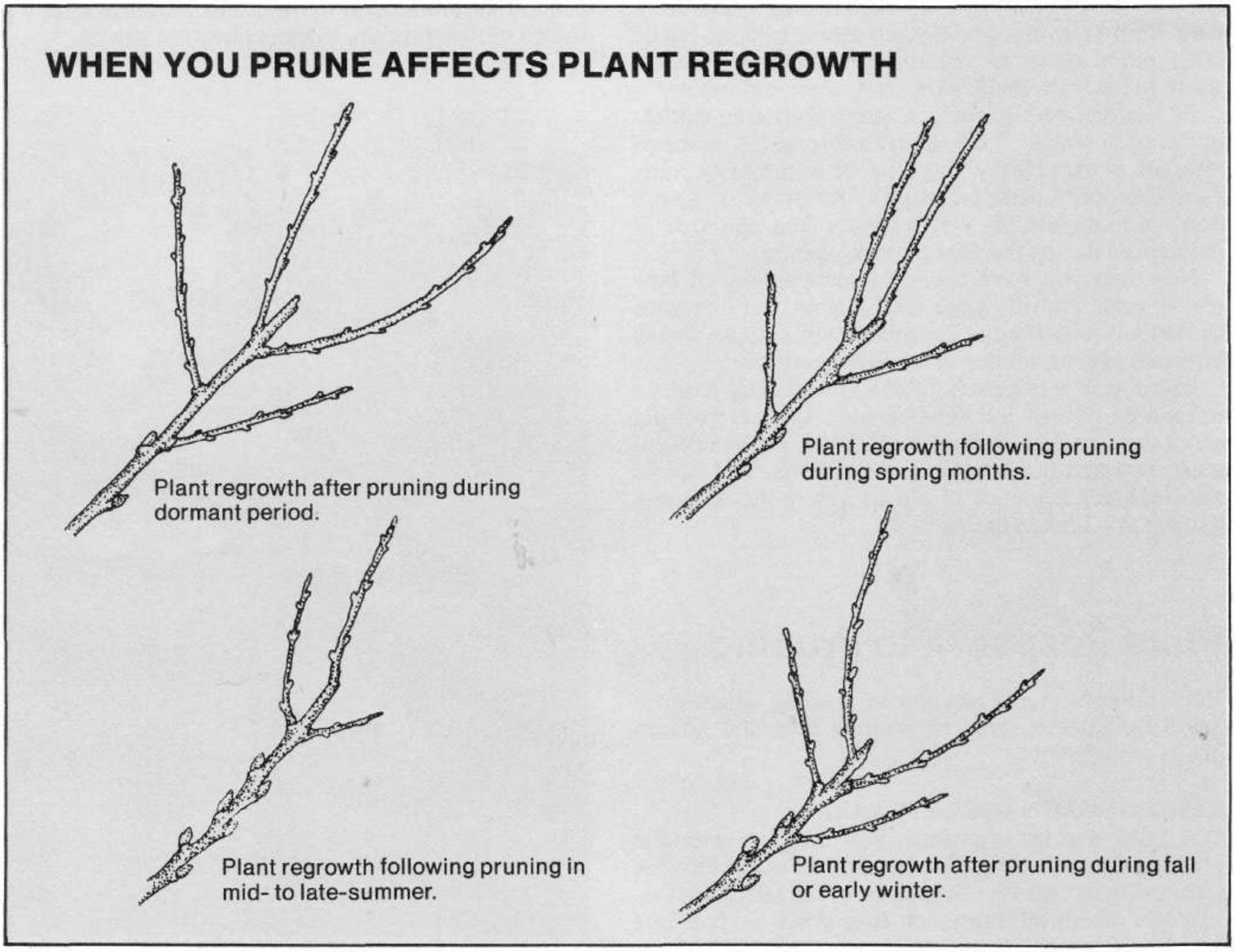
Dormant Season, Late Winter—This occurs during cold winter months in most parts of the country, regardless of the region's climate. Little internal activity is taking place in plants and insects are not active. Pruning during the dormant season usually stimulates extensive regrowth during the active growing season. Prune when temperatures are above 20F (7C).

Late Spring, Early Summer—This period is one of heavy activity for most plants. As days become longer and temperatures rise, food begins to move throughout plants. This growth period puts energy into development of new shoots, buds and leaves. Early summer pruning may stimulate branching with little devitalizing effect on plants.

Summer—Pruning during summer has a devitalizing effect on plants and may cause permanent injury. Pruning wounds cause stress. Energy needed for growth is expended on healing wounds. Wounds are more susceptible to invasion by wood-rot fungi and insects in summer.

Late Summer, Early Fall—Pruning in this season makes plants more sensitive to injury during early freezes. Pruning delays acclimation and reduces starch reserves for next season's growth.

Fall, Early Winter—Pruning in late fall or early winter before plants become dormant increases sensitivity to freezing for at least 2 weeks afterwards. This could result in serious injury and possible death to plants.



A deciduous tree's response to pruning varies with the season. The most regrowth will occur in spring if pruning is done during the dormant season. Pruning during spring will result in a lot of thin, narrow-angled regrowth the same season. Pruning during mid- to late-summer will result in the most dwarfing and little regrowth. Pruning during fall months will produce results similar to pruning during dormant months.

TYPES OF PRUNING CUTS

All pruning cuts can be classified as either *heading* or *thinning*. Heading and thinning have opposite effects, but both are beneficial to plants.

Heading—This procedure removes part of a shoot or branch, but not at a *branch point*. The branch point is the point of attachment of a branch to the trunk or another limb. Heading increases the number of new shoots formed from lateral buds. Heading stimulates branching and makes plants shorter and denser. Other forms of heading are *pinching*, *snipping* and *shearing*.

Pinching involves removal of part of current season's growing shoot, usually with the fingertips.

Snipping removes the part of a shoot that grew the previous season.

Shearing refers to many heading cuts made along a single plane, either during the growing season or during dormancy.

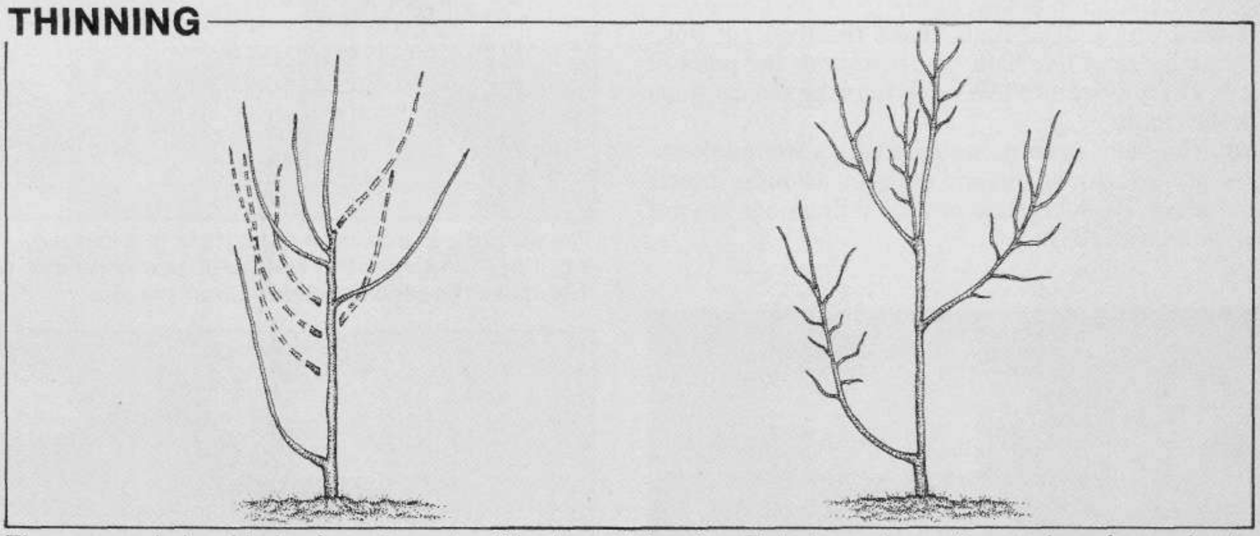
Thinning—This procedure removes an entire shoot or limb back to a branch point. Thinning reduces the number of new shoots from lateral buds. Thinning inhibits branching and lets limbs grow longer.

DEGREES OF PRUNING

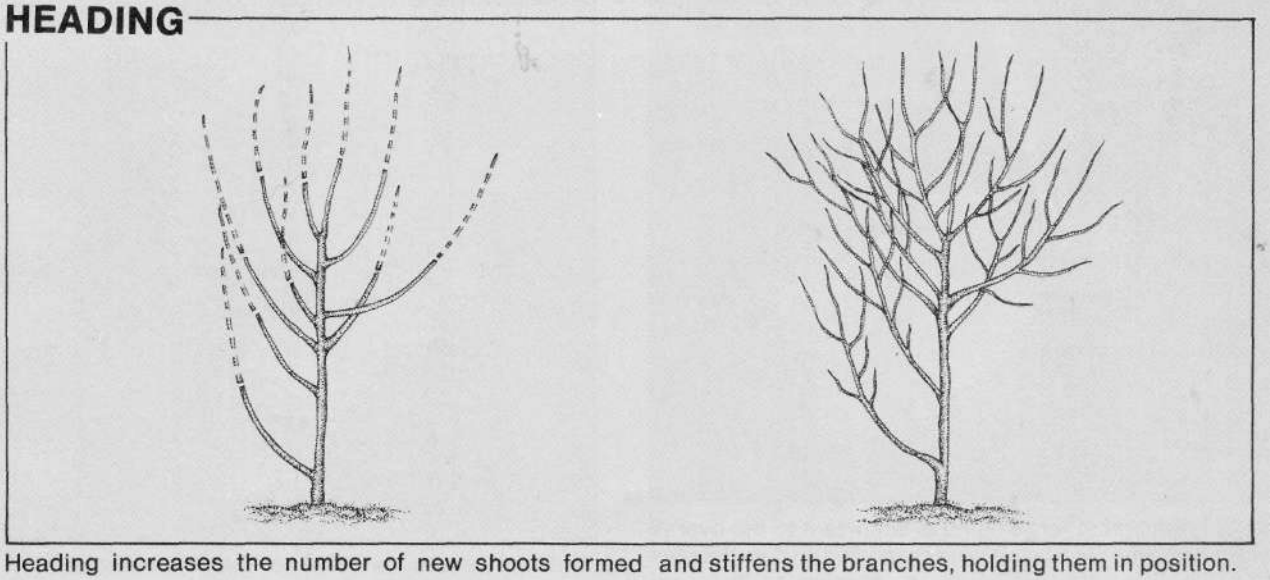
When asked how to prune a particular plant, expert gardeners often answer "Prune hard or prune light." These are general terms, but they do have consistent meanings. There are intermediate terms, too, and every gardener must interpret these terms in individual applications. The following pruning descriptions and common sense are the best guides.

Light Pruning—Suggests minimal removal of foliage or woody growth. Light pruning usually means less than 1/3 the branch length or amount of growth is removed. Plants that are not tolerant of pruning or are slow-growing should receive light pruning.

Hard Pruning—Usually means removal of two-thirds or more of the foliage or woody growth. Plants that require hard pruning are tolerant of pruning. Growth is usually stimulated by pruning.



There are only two kinds of pruning cuts, *thinning* and *heading*. Thinning reduces the number of new shoots and directs growth.



Heading increases the number of new shoots formed and stiffens the branches, holding them in position.

How to Remove Large Branches

Good training of young trees and advance planning can help prevent the need for removal of large limbs. However, removal of large, live limbs is sometimes required. The following process is recommended to remove large limbs safely and prevent further damage to trees.

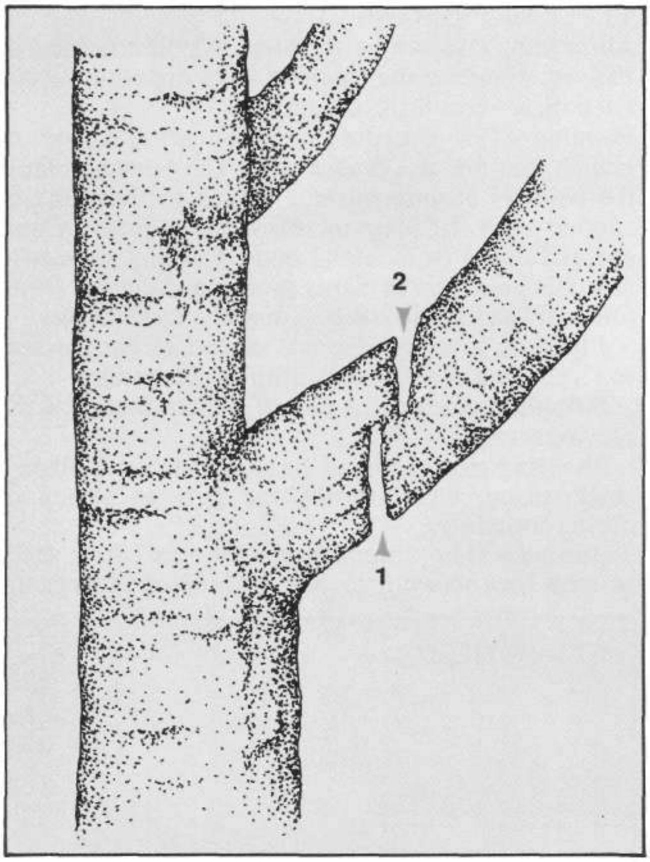
First, use a sharp saw and *undercut* the limb several inches away from the trunk. See illustration at right. When the limb falls away, it won't tear bark from the trunk. If the limb is large and heavy, tie the limb with a strong rope. The rope prevents the limb from crashing down on lower limbs or people and structures.

Make a second cut through the limb from the upper side. This cut should be made several inches past the first undercut. As this second cut is made, the limb will fall without tearing the bark.

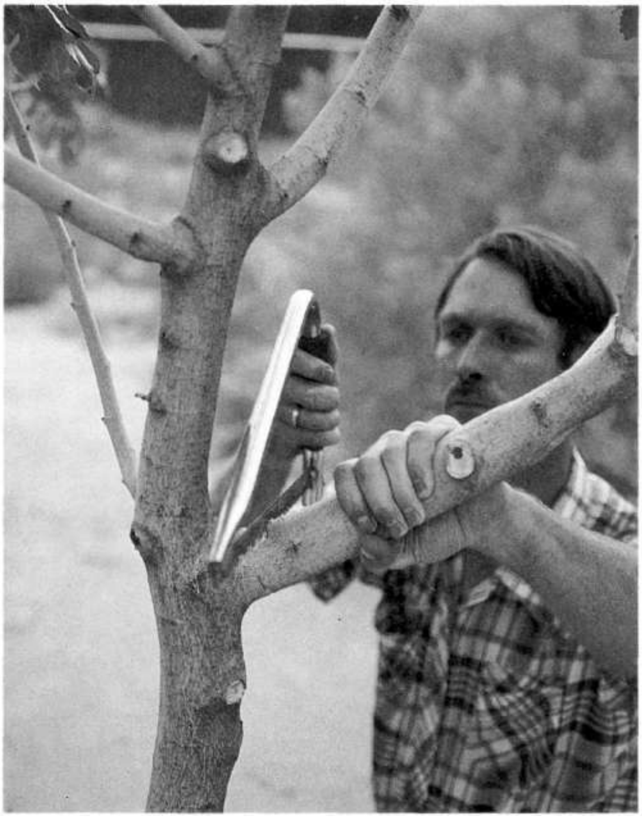
Finally, make a third cut through the remaining stub at the shoulder ring. Make this cut close to the tree trunk. Do not make the wound any larger than necessary. See illustration below, right.

If removing a dead limb, make the final cut flush with the bulge of live bark that surrounds the point of origin. Do not cut into live wood to make the cut flush with the trunk.

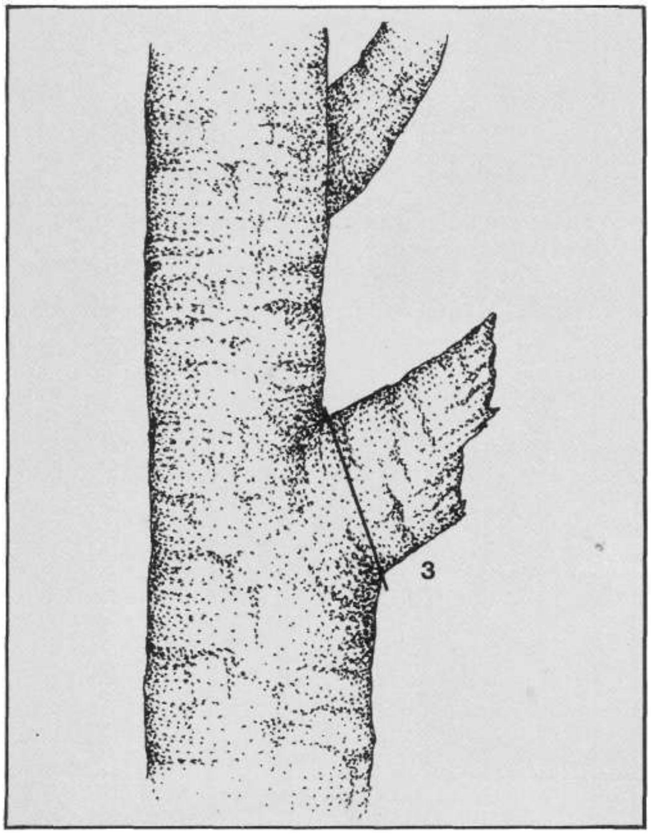
You can paint pruning wounds with a wound dressing to prevent drying out and deter invasion by insects and disease. However, use of wound dressings has not been proven effective.



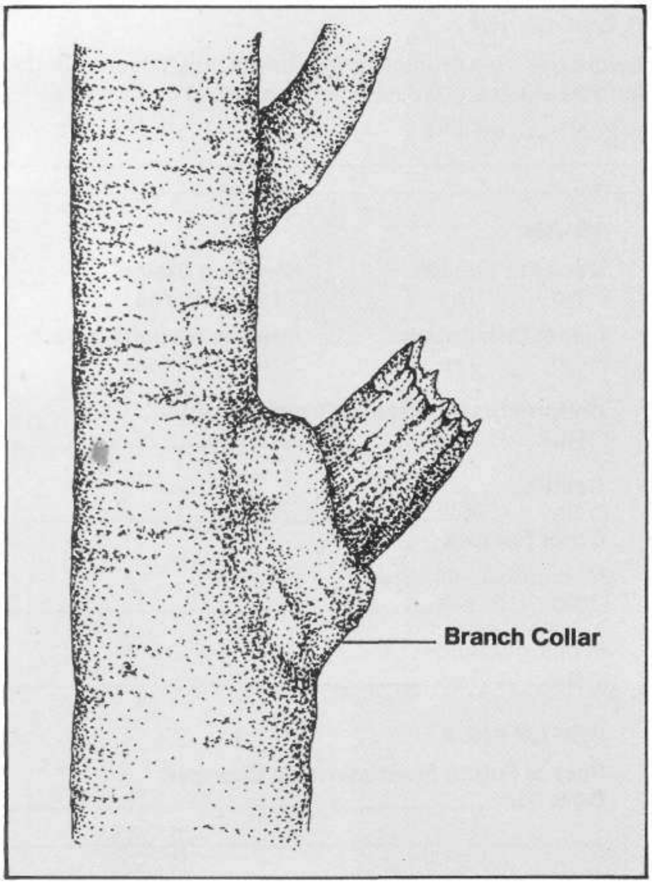
The purpose of making three cuts is to avoid bark tearing. First, undercut the limb until saw begins to bind, then make the second cut down from the top.



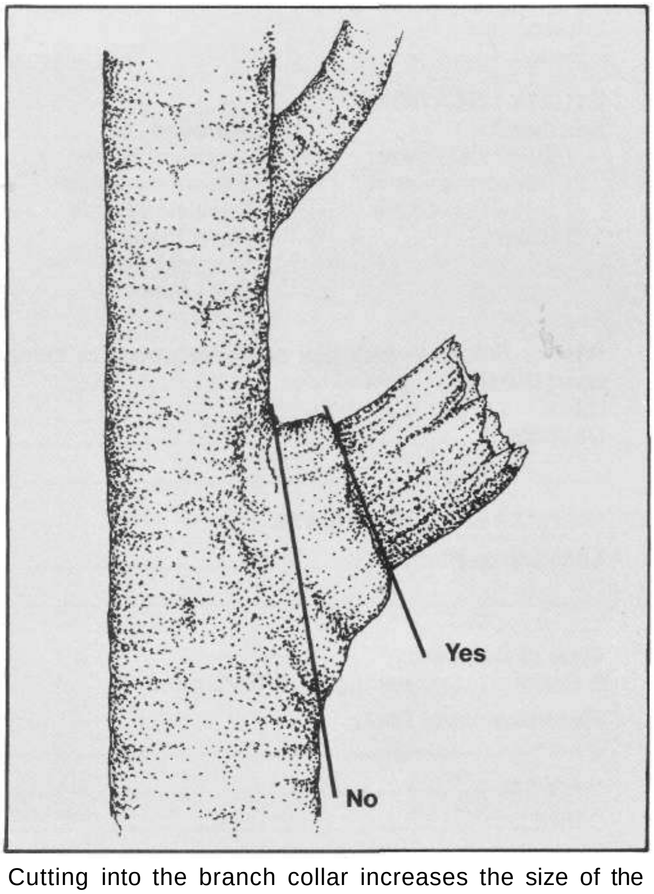
Correct removal of large limbs is important to the overall health of trees. Removing limbs incorrectly can damage the protective bark, providing an invasion point for insects and disease.



With the second cut, remove the limb completely. If it is a heavy limb, tie it with a rope to help support it. With the third cut, remove the stub close to the trunk.



Stubs heal slowly, if at all. When removing an old stub, do not cut into the branch collar.



Cutting into the branch collar increases the size of the wound and the possibility of invasion by decay fungi.

How to Evaluate a Tree

In this section you will find guidelines and a checklist to evaluate the condition of trees and shrubs. Use the checklist to determine the extent of work to be done in your yard. The checklist will help you decide what you can do and what needs to be done by a professional arborist.

You may benefit from the services of a consulting arborist if you still have questions about the condition of plants in your yard. An arborist is a specialist in the planting and maintenance of trees. For a nominal fee the expert comes to your property, identifies plants and evaluates their condition. The expert makes recommendations for tree care and provides specifications for that work. The arborist may or may not be able to do the actual work. This may mean you will need to hire a tree-care service.

If you find trees needing extensive care, ask these questions to determine the need for professional assistance:

- Do I have the knowledge, skill and physical ability to perform necessary work correctly and safely?
- Do I have the tools and equipment necessary to ensure safe and efficient completion of the task?
- Am I able to dispose of debris created by the work?

Carefully examining plants, shrubs and trees can help spot potential problems before they cause irreparable damage to your garden.

Plant Condition Checklist

Evaluate your trees and shrubs using the following checklist before calling a professional arborist. You'll learn how the arborist looks at your trees and shrubs. Communication between you and the arborist will also improve.

NAME OF PLANT
Common ______
Botanical ______

PLANT LOCATION ______

FOLIAGE

- ☐ Lush, uniform distribution, vigorous new growth.
- ☐ Stable, uniform distribution, moderate growth.
- ☐ Poor, dead tips, sparse distribution, no new growth.

TREE STRUCTURE

☐ No "V" or weak crotches.
Describe size and appearance of weak crotches.
______

LIMBS

Small—less than 2-inch diameter.
- ☐ No evidence of dead interior wood.
- ☐ Moderate, less than 5% buildup of dead interior wood.
- ☐ Heavy, more than 10% buildup of dead interior wood.

Large—4-inch or larger diameter.
- ☐ No large dead limbs.
- ☐ Moderate, less than 10% buildup of dead interior wood.
- ☐ Heavy, more than 10% buildup of dead interior wood.

Decay or Fungus
☐ No ☐ Yes

Cavities
- ☐ None evident.
- ☐ Less than 10% cavities. Average outside dimensions less than one-half limb diameter.
- ☐ Many large cavities, 30% or more of limb diameter affected.

Other Factors

Broken limbs
☐ No ☐ Yes ______

Tree supports or wires
☐ No ☐ Yes ______

Pruning wounds
☐ No ☐ Yes ______

Other wounds
☐ No ☐ Yes ______

Are wounds healing?
☐ No ☐ Yes ______

ROOTS

Excavations or Obstructions In Root Area
☐ No ☐ Yes ______

Damage To Roots
☐ No ☐ Yes ______

Roots Exposed
☐ No ☐ Yes ______

TRUNK

Decay or Fungus
☐ No ☐ Yes

Bleeding Stains
☐ No ☐ Yes

Insect Infestation
☐ No ☐ Yes

Dead or Sloughing Bark
☐ No ☐ Yes

Uniform Distribution of Growth Cracks
☐ No ☐ Yes ______

Cavities
☐ No ☐ Yes ______

Other Factors

Mechanical damage
☐ No ☐ Yes ______

Pruning wounds
☐ No ☐ Yes ______

USE OF AREA

Past or Future Environmental Changes
Describe: ______

SURROUNDING ENVIRONMENT

- ☐ Residential Lawn or Garden
- ☐ Residential Planting Strip
- ☐ Commercial Planting Strip
- ☐ Easement
- ☐ Park

UTILITY LOCATIONS

Overhead
- ☐ Electrical Power
- ☐ Telephone Cable
- ☐ Television Cable
- ☐ Other

Underground
- ☐ Electrical Power
- ☐ Telephone Cable
- ☐ Television Cable
- ☐ Water Lines
- ☐ Sewer Lines
- ☐ Gas Lines
- ☐ Other

Past or Future Installation of Underground or Overhead Utilities.
☐ No ☐ Yes
Describe: ______

INSECTS or ANIMAL PESTS

Location on Plant: ______

Type of Damage:
☐ Boring ☐ Chewing ☐ Scratches

Identification of Pest:
- ☐ Insect ______
- ☐ Animal ______
- ☐ Bird ______

Control Measures: ______

Pruning Tools

It's essential to have proper tools to do a good job of pruning plants. The correct tool makes tasks easier and more enjoyable, with less chance of injury to plants.

There are many types of pruning tools available. Tools differ in size, shape and cutting action. Every tool has advantages and disadvantages. Quality can range from poor to excellent, with varied prices.

Regardless of the type, size or price of the tool, buy the best-quality tool you can afford. A good tool costs a little more, but it cuts cleaner, works easier and stays sharp longer. A low-quality tool never works as good as a high-quality tool. A low-priced, low-quality tool can end up being an expensive purchase.

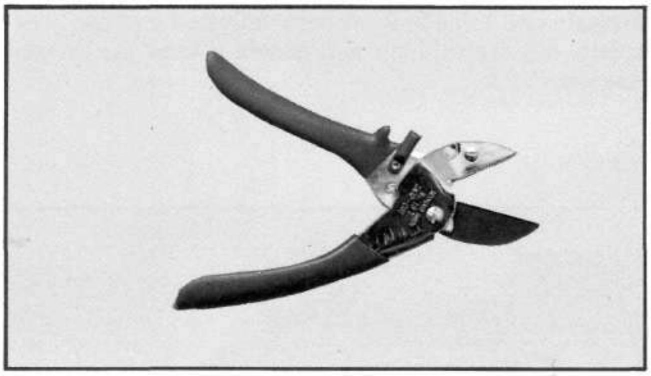
Tools described in this section are common types available in hardware stores, home centers and garden shops.

ONE-HAND PRUNING SHEARS

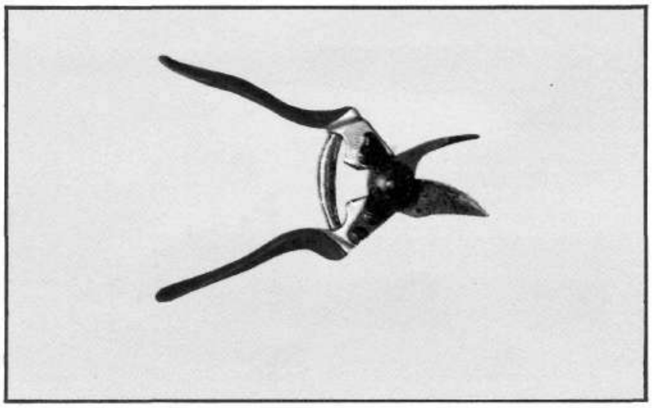
Two basic types of one-hand pruning shears are available. Both shears are designed for light-pruning cuts. They each have advantages and disadvantages. The choice between the two shears is a matter of personal preference.

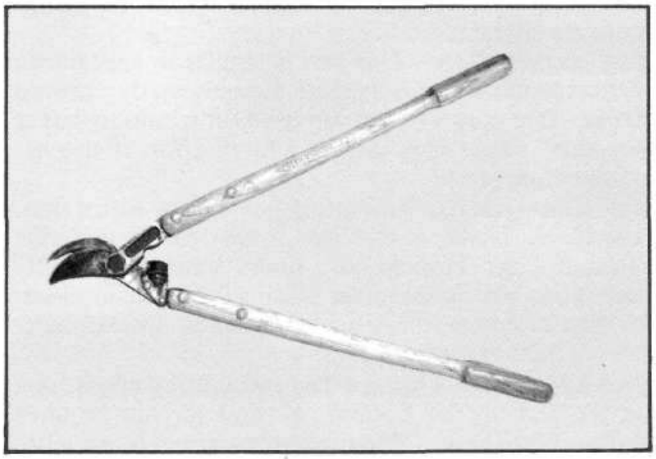
Anvil Type—These shears cut by action of a straight blade against an anvil. Anvil-type shears are less likely to be sprung open if used for too-heavy a cut. Some gardeners believe anvil shears have a tendency to crush a stem or branch instead of cutting it.

Hook And Curved-Blade Type—The action of this tool resembles scissors. The hooked blade holds branches and the curved blade cuts branches. These shears have a tendency to spring open if used on large branches.



Anvil-type hand-pruning shears work with action of cutting blade against a solid anvil.





Long-handled lopping shears provide more cutting strength for large limbs. Hook and curved-blade type is shown.

TWO-HANDED LOPPING SHEARS

Long handles and two-handed action of these tools gives greater cutting strength.

Lopping shears are available in anvil type, or hook and curved-blade type. The hook and curved-blade type is more popular. The hook lets you catch hold of the branch.

Toppers can be purchased with 15- to 30-inch-long handles. A pair with short handles is useful for close work. A pair of lopping shears with long handles is better for general use throughout the garden. The limiting factor in selecting size of loppers is weight. Heavy, long-handled loppers are awkward to use at arm's length or above your head.

Expensive loppers have real hickory handles, or possibly fiberglass or metal. Loppers with handles made from hickory, fiberglass or metal are better than loppers with thick, heavy handles of ordinary wood. Desirable features for loppers include a good spring-action or rubber bumper under the jaws. Drop-forged jaws are better than stamped-metal ones.

Compound action, ratchet-type or geared loppers are available. These types of loppers allow more leverage for cutting larger limbs. They are easier to use and cost more than regular hinge-action loppers.

SAWS

Pruning saws come in a variety of styles to fit different situations. Many saws have teeth that cut only on the pull stroke. These blades make it easy to cut overhead branches.

Folding Saw—Smaller folding saws are easy to carry in pockets. Folding saws have fine teeth, usually 8 to 10 per inch. Fine-toothed saws make fine, close cuts on smaller branches. Larger branches can be cut easier with other types of saws.

Rigid-Handle Curved Saw—These saws have blades 12 to 16 inches long and a big handle for a good grip. Curved saws with *raker* teeth have a deep slot after every fifth saw tooth to carry away sawdust. Raker teeth work best for cutting green wood. Curved saws with lance teeth are best for cutting deadwood. Lance teeth are all the same size.

Tree Surgery Saw—This saw is similar in appearance to a carpenter's saw. The teeth cut only on the forward stroke. Tree surgery saws are used for trimming larger branches. These saws require a lot of effort to use because of fine teeth.

Bow Saw—Handy, fast-cutting type of saw with a thin, replaceable blade. A bow saw is easy to use and cuts through large branches or limbs quickly. The 21-inch-blade size is the most practical. The main disadvantage of a bow saw is it cannot cut as close as other saws in tight or crowded locations.

Two-Edge Saw—This saw has two cutting edges, one on top and one on bottom. A two-edge saw requires skill and care to use. The two-edge saw can cause more damage than it corrects. The main disadvantage is that when cutting with one edge of the blade, the other edge may also be cutting the tree.

Chain Saw—These modern labor-saving workhorses are quick and easy to use. Chain saws perform a variety of pruning chores around the yard or garden—from light trimming to complete tree removal. Manufacturers have different models and sizes. Many manufacturers offer both electric- and gasoline-powered models.

Chain saw size is determined by length of the *cutting bar*. Chain saws may range in length from small 10-inch models to large, heavy-duty models with a cutting bar over 4 feet long.

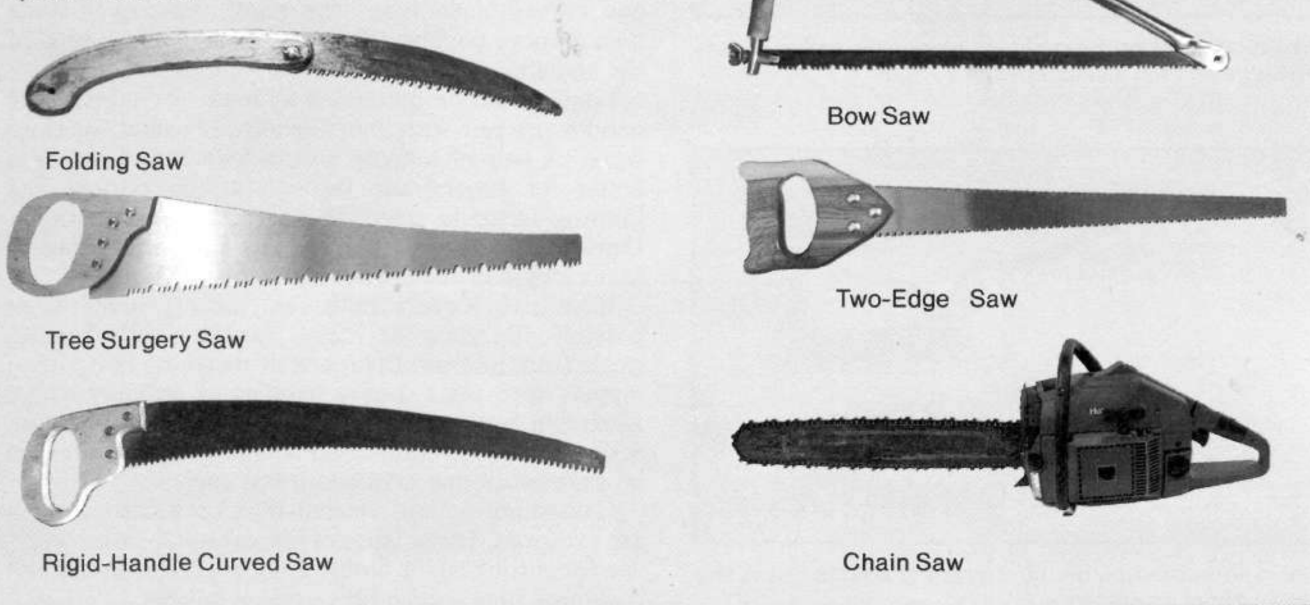
Electric-Power Chain Saws are economical to operate, easy to use and quiet. They require little maintenance and can handle many pruning chores around the home. They should be used with a properly grounded, *UL-listed* outdoor extension cord. UL-listed refers to products tested and listed by Underwriter's Laboratories, Inc. See page 157. Avoid tripping over or cutting the electric power cord during operation. The biggest disadvantage to electric chain saws is operating range, which is limited by the length of the extension cord.

Gasoline-Power Chain Saws are larger, more powerful and more expensive. They require more maintenance and adjustments, but offer complete portability and convenience. The 12- to 15-inch-blade is a versatile size for homeowners. This size has enough power to handle all but the largest pruning jobs and is lightweight and easy to maneuver for light pruning operations.

All chain saws, both electric and gasoline, are potentially hazardous. They are sharp, fast-cutting tools and should be operated with extreme caution. Chain saws are safe and reliable if properly adjusted and used correctly, but are difficult and unsafe if used incorrectly. See page 25.

TYPES OF PRUNING SAWS

This collection of pruning saws illustrates the many types available to gardeners. Some are used only for specific reasons.



LADDERS

A good, safe ladder is one of the most important tools for pruning work. A ladder provides a secure platform to work from and lets you extend your reach safely. Ladders come in all sizes, from 4-foot-tall stepladders, to towering extension ladders reaching more than 40 feet high.

The best ladders are made from wood, fiberglass or aluminum. Wooden and fiberglass ladders are heavy and strong. Aluminum ladders are lightweight and strong.

Stepladders—There are two basic styles of stepladders. The most common is the four-leg *household ladder*. The household ladder is not recommended for use in gardens or orchards. Four-leg ladders are unstable and dangerous on uneven surfaces or soft earth.

The best stepladder for gardeners is called an *orchard ladder*. The orchard ladder has three legs and a wider stance. Orchard ladders come in various sizes. The 6- or 8-foot model is most useful. Larger sizes are heavy and difficult to use.

In setting up an orchard ladder, make sure the third leg is an equal distance from the other two. No leg should be resting on soft dirt, a slippery surface or in a gopher hole. If unsure about stability of the ladder, tie the ladder securely to the tree or don't climb on it.

Extension Ladders—These ladders are perfect for reaching higher parts of a tree. Extension ladders have two or more sections nested inside one another. Sections are interlocked by guides. The guides allow one section to slide inside another and extend to the desired height. For general use, extension ladders in 16-foot, 20-foot or 24-foot lengths are most practical. The ladders are tall enough to reach most areas of a tree and still lightweight enough to move easily.

Wooden extension ladders are heavy and expensive. Aluminum extension ladders are lightweight and relatively inexpensive. They are most often purchased. Care should be taken when using a metal ladder outdoors, because aluminum is an excellent conductor. The metal ladder must not contact any electrical wiring or power lines.

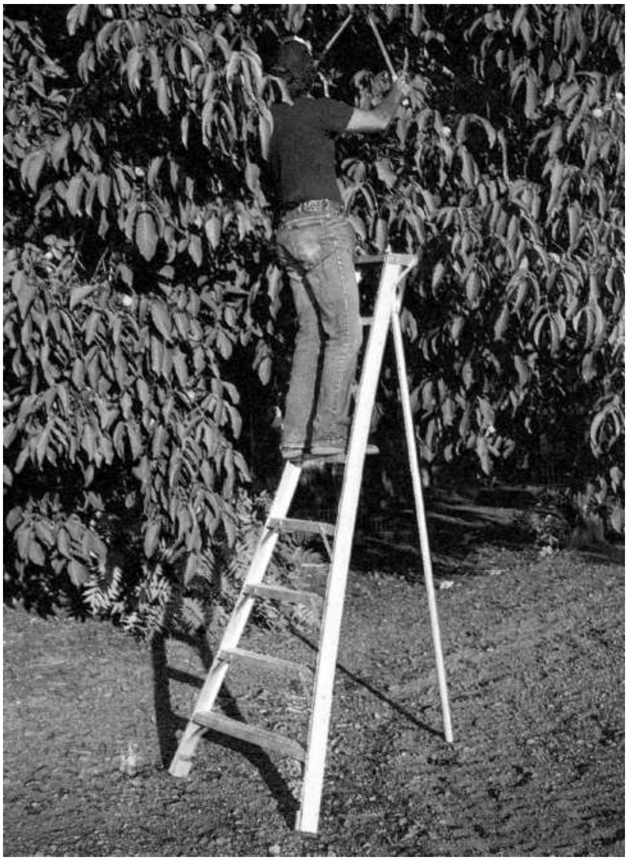
Be careful in placing the ladder's feet. One foot in soft dirt can cause a ladder to tip as you climb it. Don't lean too far over to one side when standing on an extension ladder. Leaning can cause the ladder to slip and fall over. To prevent an extension ladder from falling over, tie it to the tree.

SAFETY EQUIPMENT

Protection is the key word here. Any safety equipment that provides protection to you—your hands and fingers, face and eyes, feet or any part of your body—is an essential tool. Safety equipment to protect you during any pruning operation should be the first tools you pickup.

Basic protection items include gloves, boots or sturdy shoes, long-sleeved shirt, pants and perhaps a hat.

One important piece of safety equipment highly recommended is a good pair of safety goggles to protect eyes from pruning cuttings and debris. Safety goggles are essential when using electric hedge shears or a chain saw. Ear plugs are also essential when using any chain saw, gas or electric powered.



Orchard ladder is safest model for use in gardens. Three-leg model provides stability on uneven or soft ground. For safety, never stand on the top two steps of any ladder.

Some type of safety belt is recommended if climbing a tree without a ladder. Professional safety belts are expensive, but so is a hospital stay from a broken leg or concussion. A strong rope can be used to secure you to a tree. The rope may be uncomfortable, but it can save you from a fall and serious injury. Tie the rope around your waist securely, then tie it around the tree trunk.

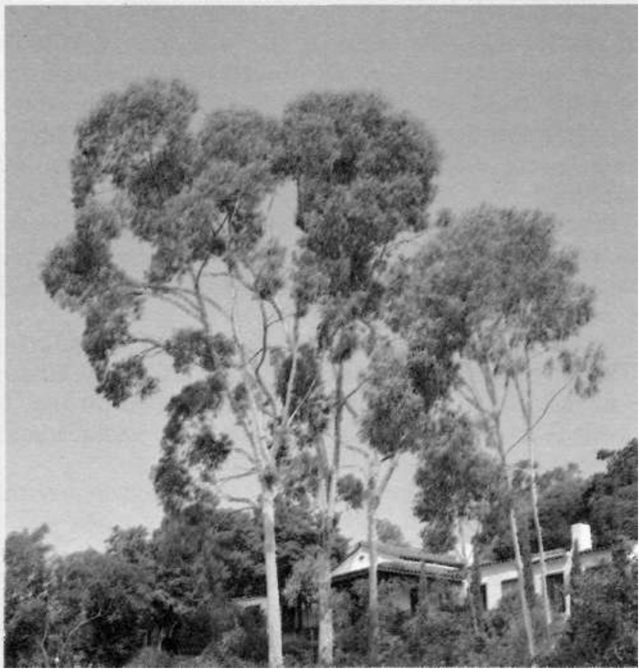
If you are uncomfortable about climbing a tree or working on a tall ladder, consider calling an arborist or tree service to handle the job. See the section on *How To Evaluate A Tree* on page 19 for more information.

Electricity Kills

Pruning a tree can put you in touch with sudden dearth! Each year thousands of homeowners are electrocuted when pruning tools, ladders, or bodies come in contact with energized power lines. A 230-volt houselead can kill, and so can an ordinary 115-volt extension cord.

Carefully check to see if a line of any passes through a tree before attempting to prune. Look carefully. Sometimes lines and cables are difficult to locate. Consider all lines to be energized and carrying lethal voltage. Call the local utility company for help. Commercial line-clearance companies are required by law to maintain 10 feet of clearance between tree limbs and all electrical wires.

Tree Wounds and Diseases



This large, spacious tree has received good care and proper pruning to reach this size. It is healthy and attractive, providing plenty of shade for its owners.

The following information has been provided by W. Douglas Hamilton. He is horticultural advisor for the University of California's Cooperative Extension Service, serving Alameda, Contra Costa and Santa Clara counties.

Trees are an important part of our natural surroundings. If undamaged, trees can live for years. Unfortunately, trees are damaged by a wide variety of natural and unnatural causes. This damage creates wounds, which are a normal part of a tree's life. If tree wounds are treated promptly and correctly, only scars will remain. Wounds can destroy entire trees if left untreated. This section explains what tree wounds are and discusses treatments to help heal wounds.

Additional information is provided on diseases, decay and treatment to prevent further damage to trees. This information is based on research results plus practical suggestions from arborists. This section should help you make decisions for treatment of tree wounds.

CAUSES OF WOUNDS

Scars are left by fallen leaves and limbs. Stubs are left by fallen dead branches. Orchard and city trees are subjected to damage from automobile accidents and lawn mower blades. Trees are beaten by baseball bats. Holes are made by nails and fence staples. Branches can break during storms. Limbs can split and burn from lightning. Fire, insects and animals create small and large wounds such as scrapes, punctures and breaks. In many cases, trees are neglected by society. All these wounds provide entrance points for insects, disease, wood-rotting fungi and decay.

A tree wound is any injury that damages living tissue. Living tissue includes external bark, phloem, cambium and sapwood in the xylem. Non-living heartwood in the xylem may also be damaged.

Branch stubs are especially susceptible to infection by decay-causing organisms. These organisms create discoloration and decay in living trees.

RESPONSE TO DAMAGE

Trees have active defenses against wounds. When a wound occurs, specific chemical and physical changes take place in tissues around the wound.

A waterproof covering of *suberin* is quickly produced over the tree's live cells. Suberin protects tissues from sunburn and prevents drying out. In many cases, resin or sap may flow from wounds. Resin helps defend nonliving heartwood from invasion by fungus and bacteria.

As wounds heal, cells begin to divide from the cambium layer. Cells create protective tissue called *callus.* Successive layers of callus form over wounds from the outside to the inside or center of wounds. Callus prevents entrance of decay organisms into inner tissue of trees.

Callus growth is encouraged by protecting wounds from heat, light and drying for four to eight weeks after injuries. This is where suberin plays an important role—protecting injuries from heat, light and drying.

After callus has formed over wounds, an additional covering is created by normal production of new phloem, xylem and *cork.* Cork is sometimes called *inner bark.* If wounds are covered rapidly, deadwood in wounds is protected before decay-causing organisms become established. At present, there is no proved way to increase rate of wound closure, except to increase vigor in trees.

Protective wound dressings are often added to the tree's natural protective responses. Wound dressings are discussed in greater detail later in this section. See

NON-DECAY ORGANISMS FIRST

Fresh wounds provide an attractive habitat for many microorganisms. Bacteria and non-decay fungi are first to appear on wounds. Few of these specific microorganisms can grow into wood. Crown-gall bacteria and cankers caused by *Ceratocyctis* and *Cytopspora* fungi are good examples of non-decay fungi.

Organisms that do grow into wood must pass through protective chemical barriers produced by trees. These chemical barriers are called *phenolic compounds.* Some organisms can pass these chemical barriers. Most organisms never get inside trees.

Deep wounds in a tree's heartwood produce no protective response from non-living tissue. Deep wounds are highly susceptible to invasion by decay fungi.

DECAY ORGANISMS SECOND

Decay fungi, *Hymenomycetes,* are the next microorganisms to invade tree wounds. Decay fungi appear after wood around wound has died. This makes sense, because decay is the breakdown or decomposition of dead organic matter. When tree wounds are not covered by callus, decay usually occurs.

Decay can occur within one year in some trees. Decay can take from two to ten years to appear in other trees. Protection of open wounds should continue until wounds have healed.

Healthy, vigorous trees slow decay. Years of research and practical experience suggest the more vitality a tree has, the stronger the protective response is to decay. In weak trees with little vigor, decay is rapid. Decay is rapid in older, mature trees with slow growth. Decay is also rapid on wounded trees that have been defoliated during the growing season.

LIMITS TO DECAY

Decay does not normally involve the entire cross-section of a tree's limb or trunk. There are natural limits to the spread of decay in a tree. The greatest diameter of decay in any tree is the diameter of the tree at the time of the injury. New tissues form each year, always outside the injured area. Decay does not spread into new, living tissues formed after injuries. In effect, trees are compartmentalized multiple plants, capable of walling-in injured areas.

BARRIERS TO DECAY

Tree decay is slowed and halted by four distinct barriers. The first barrier is the plugging of live cells immediately above and below the wound. This barrier is easiest for decay organisms to breakthrough. Live cells must be plugged before decay occurs to prevent damage to the tree. Plugging is a dynamic process that depends on many factors. Long, discolored compartments are formed when the plugging process is slow. If plugging is fast, compartments are shorter.

The second barrier to decay is the live, inner growth ring. This is the first layer of living cells under the bark of trees. The growth ring is continuous from the top to the bottom of a tree. The inner growth ring is the second weakest barrier. If wounds are deep, this layer of cells is damaged. Decay fungi are not stopped from entering.

Side walls of trees form the third barrier. Sidewalls are *ray tissues,* or sheets of cells that form across tree rings. Rays form from the center of trees out to the sides. Discoloration and decay does not appear to follow ray tissues into the center of trees beyond injured rings, but the edges of ray tissues usually appear ragged.

The cambium layer is the fourth and strongest barrier. The cambium layer is found just inside the bark. Strength of this barrier depends on many factors, including size, type, position and severity of wounds.

The time of year when wounds occur and a tree's genetic sensitivity to damage have some influence on effectiveness of these barriers.

Decay is slowly spreading throughout the trunk of this large tree. Entry was provided through a wound created by improper removal of a large limb.

Callus growth helps prevent the entrance of decay organisms. Callus also protects wounds from sunlight and drying out.

These four barriers compartmentalize damaged tissue, keeping damage confined. These barriers are particularly effective in young, vigorous trees. Confinement is less in older trees or trees with large amounts of heartwood.

WOUND CLOSURE IS IMPORTANT

A tree's most important defense against decay is rapid closing of wounds. A tree is never safe from invading decay fungi until wounds are completely covered with living tissues. Decay continues to eat away at tree trunks long after wounds have sealed. Many factors influence how quickly tree wounds close. These influences include:

- *Current Growth Rate*—This refers to how fast trees grow in height, diameter and root spread. A good indicator is rate of callus formation over wounds.
- *Wound Size*—If pruning cuts are made flush with the trunk, wounds are large and slow to heal. If short stubs are left, wounds are small and close rapidly.

Pruning cuts should be made outside of shoulder tissue, slightly away from the larger limb. These cuts are made just outside the first protective barrier. See page 19.

- *Number of Wounds*—The more wounds, the longer wounds take to close over. The fewer the wounds, the quicker the closure.
- *Location of Wounds*—If all other factors are equal, wounds low on a trunk will close quicker than wounds higher on the trunk.
- *Genetic Influence*—Some trees decay more rapidly than others. Willows, cherry and other short-lived trees decay quicker than conifers or oaks.
- *Tree Age and Vitality*—Young, vigorous trees close wounds quickly. Older, slow-growing trees close wounds slowly.
- *Season Wounds Occur*—Wound closure is usually quickest when wounds are made just before or at the beginning of spring growth. This means pruning should usually be done in late winter or early spring. See page 16 for more information on when to prune.

The second-fastest healing period occurs in early summer, after new leaves have expanded fully. Late fall and early winter are the worst periods for wounds, primarily due to large amounts of fungal spores in the atmosphere. Tree wounds also close slower if wounds occur when buds and leaves are expanding. This is because food reserves are lowest at that time. Plant energy is directed into growth instead of healing.

Removal of large limbs creates fresh tree wounds. Rapid closing of wounds with callus growth or an artificial covering is an important defense against decay.

WOUND TREATMENT

Wound Shape—Proper treatment of wounds promotes callus growth and ensures rapid healing of wounds. Some arborists shape bark wounds on branch and trunk surfaces in an elliptic pattern. Research shows the shape of the perimeter of bark wounds does not influence callus formation. In other words, it makes no difference if wound shape is elliptic, round, or square. Some arborists do advise against making sharp angles on wound edges. Don't widen wounds more than necessary. Trim loose bark parallel to the wood grain. Use a rasp or coarse sandpaper to smooth rough edges. All bark around wounds should be tight. Remove all loose bark or press the bark into place.

Chemical Treatments—Trees diseased or infested with insects may require treatment with chemical insecticides, fungicides or nutrients. Chemical treatments cause varied reactions in different trees. Injection of some insecticides can be highly *toxic,* or harmful to young wood tissues. Nutrient injections of manganese, magnesium, iron and zinc cause a minor amount of damage to some trees. Application of Benzimidazole fungicides encourages decay in some trees.

Limited research indicates applying large amounts of the fungus *Trichoderma harzianum* may delay invasion of wood-decaying *Hymenomycetes* for at least two years in red maples. After two years, decay fungi gains dominance and wood decays. Under natural conditions, *Trichoderma harzianum* directly invades decaying wood at the edge of injured tissues, but it is not effective at slowing decay. The artificial application of *Trichoderma,* followed by covering treated wounds with black plastic sheeting, may have promise as a wound treatment. It needs to be studied by scientists to determine just how effective it can be.

Arborists recommend chemical treatments to prevent spread of the following diseases be applied to pruning wounds. The diseases are:

Crown Gall is a bacterial disease of young, established trees of many species. Anti-bacterial prepara-

lions, such as Galltrol and Gallex, are effective in preventing infection.

Eutypa is commonly called *dieback* in apricot trees. Dieback is characterized by tips of twigs and branches dying backward toward the center of trees. Dieback is a wound-invader. Dead branches should be cut and removed. Prune infected branches al least 8 to 12 inches below visible damage. Apply benomyl fungicide to cuts.

Wound Dressings —A classic definition of a wound dressing says: 'ideally, it should disinfect, prevent entrance of wood-rotting fungi, stimulate callus and be toxic or harmful to parasitic organisms." Unfortunately, no one treatment meets all those qualifications.

Tree pathologists have found some compounds, such as copper and creosote, to be harmful to living tissues. Water-soluble asphalt emulsions are believed to stimulate callus growth in some cases. But asphalt-based dressings tend to crack and provide less protection against drying.

Newer paints are made with a poiyvinyl-acetate base. These paints maintain an elastic, durable, crack-free protective coat.

Some tree pathologists suggest that tree-wound dressings are strictly cosmetic and have no positive influence in healing wounds. Others pathologists disagree, recommending use of wound dressings for all wounds and pruning cuts. Conclusive scientific evidence is lacking.

Drains—In most situations, it is not advisable to install drains through live and uninjured tree tissue. Installing drains may create new wounds. Drains may not have any influence on the healing process.

Cavities- In almost every case, it is better to leave cavities open. One exception to this is installation of a smooth surface across a large cavity. This provides a surface for callus to grow on and the shortest distance to cover wounds. Arborists have used concrete, asphalt and even *polyurethanefoam with* success. Polyurethane foam is a synthetic material.

Caretul training and correct pruning practices have helped produce these beautiful ornamental trees. These trees illustrate good form and height control. They will maintain their health and beauty for years.

Training and Pruning Fruit Trees

Fruit-bearing trees and vines combine beauty and practicality. These plants serve as attractive and colorful focal points in gardens and provide delicious fruit.

Fruit trees and vines require proper care and plenty of attention. This includes frequent watering, fertilizer applications and careful pruning.

Pruning keeps trees and vines attractive, under control, healthy and productive throughout their lives.

This chapter is divided in two sections. The first part explains basic principles of training and pruning for fruit-bearing plants. The second part provides specific pruning information for common fruit and nut trees.

Planting and training semidwarf apples at this acute angle increases productivity and makes harvesting easier.

TRAINING YOUNG TREES

Training young fruit trees is important. Training develops branch frameworks and helps trees fit in the proper spaces in gardens. Training also helps trees arrange leaves for maximum exposure to sunlight. Training involves many things, including pruning, bending, spreading and tying branches. Training normally takes three to five years of work from planting.

Strong Branches are developed through training. Strong branches hold heavy fruit crops without breaking or needing support. Some training methods, such as *trellis-palmette* and *espalier,* use some kind of support for trees.

Training shapes trees to fit the space allowed. The size of a garden and the role of trees in the landscape determin how to train trees.

Trees can be trained to be large and spreading, spherical and small, or narrow and upright. Trees can flatten against a wall or fence, or grow high to allow gardening under them. Fruit trees can be trained into hedges or as large specimens. Many fruit trees are grown in patio containers. Different training methods are required in each case. These methods are explained throughout this chapter.

Commercial orchards train fruit trees for ease of pruning, spraying and harvesting. Methods are quick and efficient, with little concern for the tree's appearance. As a home orchardist, you should train trees to be beautiful and practical.

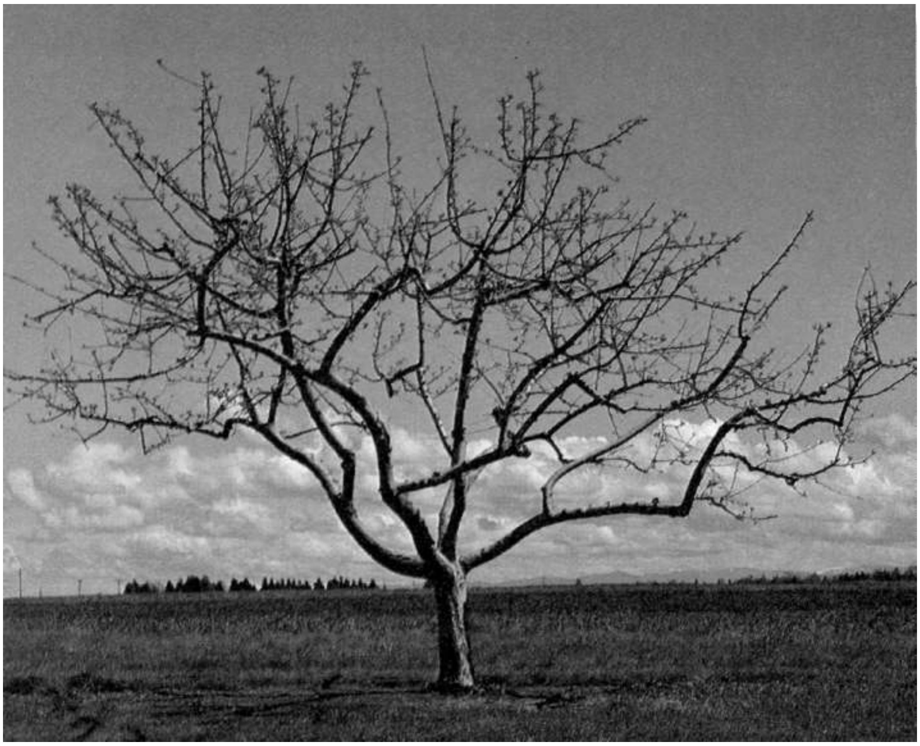
It is not always necessary to train peach trees in a vase shape, or grow apple trees in an orchard. Peach trees can be trained to an espalier form. Apples can be grown in large patio containers. Knowing the fundamentals of tree growth and a tree's fruiting habits can help you train trees successfully. See page 9 for more on basic principles of plant growth and development.

Productivity of a tree is affected by pruning. A fruit tree that has never been pruned begins to produce at an earlier age. The tree also produces more fruit in its early years. But production of fruit decreases dramatically after several years and the quality of fruit is not as good. In addition, heavy fruit loads in early years of growth may cause limbs to develop poorly. This overabundance of fruit could result in weak or damaged branches susceptible to breakage.

A tree that has been carefully pruned produces more and better fruit over a longer period with no injury to the tree. Training involves light pruning to delay fruit production as little as possible.

Nursery trees are trained differently depending on whether limbs are well-branched or poorly branched. A well-branched young tree has limbs spaced evenly around the trunk. Limbs are 8 to 12 inches apart vertically. Well-branched trees have scaffold limbs selected at planting time. The rest of the limbs are removed. Side limbs are headed back at least 1/2 their length.

Poorly branched nursery trees have unevenly spaced branches. All side limbs should be removed at



This apple tree is an excellent example of an open-centered, well-pruned mature fruit tree. Note the balance of the scaffold and terminal branches.

Dwarf and semidwarf fruit trees often produce more fruit than they can support. Use some kind of support system so crop weight does not ruin the trees.

A hedge or fence of apples is an efficient, space-saving training method. Pruning, spraying and harvesting require no ladder. Training is simple, but requires constant attention.

planting time. If young trees will be watered frequently during the first summer, leave more branches on top at planting time.

Staking is necessary to develop normal upright trees on windy sites or with certain species such as walnut. Tie trees loosely so they do not become too dependent on stakes for support.

TRAINING METHODS

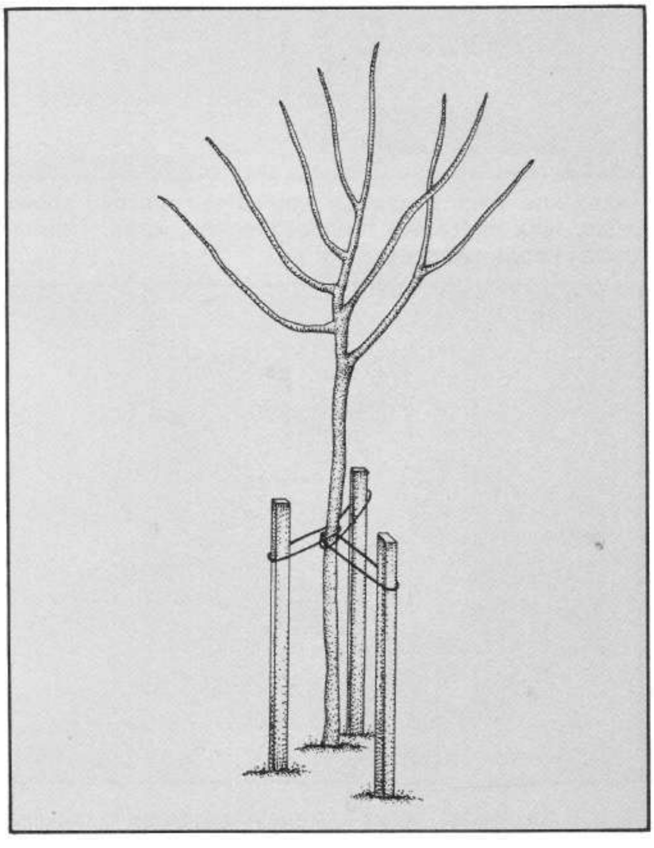
Bending, spreading, tying-out and pruning are methods used to train fruit trees to be stronger, healthier, more productive and attractive. The four methods may be used in combination.

These methods reduce influence of apical dominance by terminal buds. These methods partially or completely allow buds and shoots to grow from below terminal buds. If a limb is bent, shoots might form flower buds during the current season or the next. Spreading helps to increase fruit set if blossoms have formed.

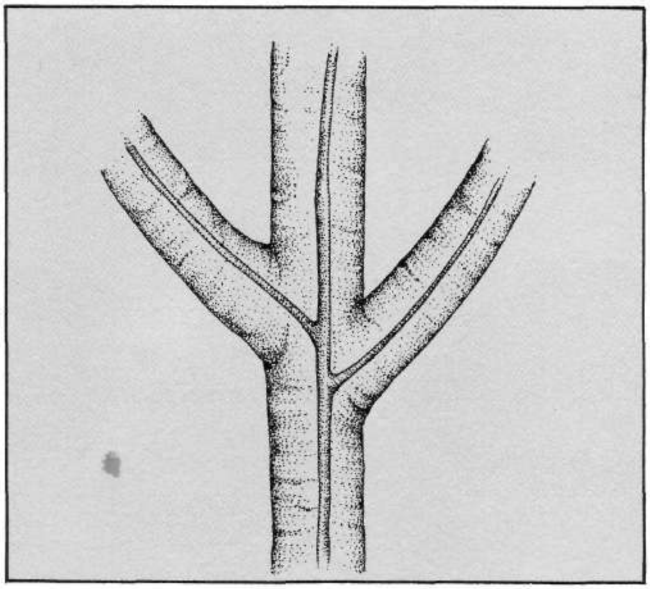
Bending—Limb bending has certain effects on trees, depending on degree of bend. Bending changes the number, length and position of side branches formed on limbs.

Bending limbs to about 30° from vertical slightly decreases length of terminal shoots. Bending also increases the number and length of side branches.

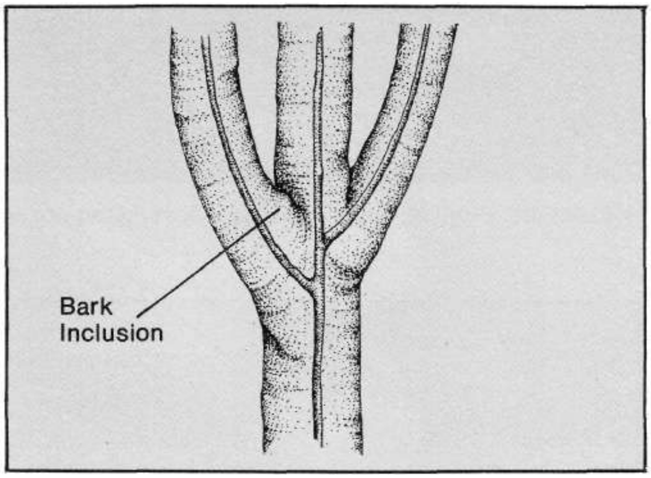
Bending limbs 45° to 60° from vertical suppresses terminal shoot growth Bending to 45° to 60° increases shoot growth on the upper side of branches away from



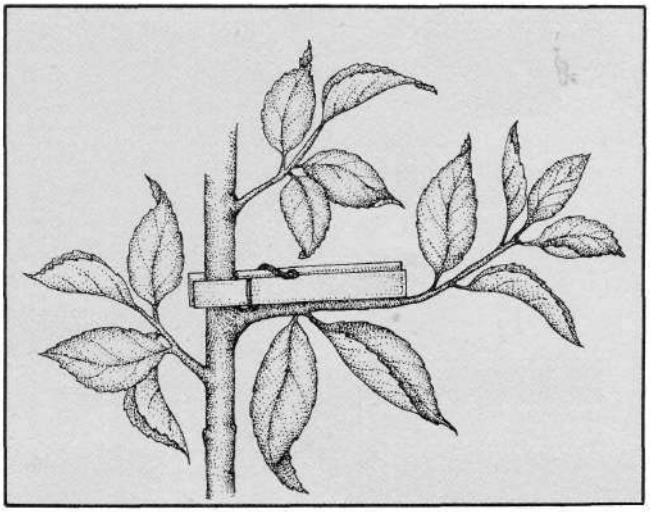
Loose staking of young trees permits some movement in wind. Movement helps develop strong trunks.



Original wide crotch angles of young tree, shown inset, will develop into wide, strong crotches as tree grows in thickness.



When the original branch angles are narrow, shown inset, bark inclusions form as the tree grows. This results in weak crotches.



One of the easiest ways to train young trees to develop wider crotches is to use spring-type clothespins. Install clothespins when shoots are 6 to 8 inches long and still flexible.

terminal buds. This degree of bending does not allow extremely vigorous growth of side shoots.

Bending limbs down to 90° horizontal or more, stimulates growth of vigorous shoots or water sprouts close to the trunk. Remove these water sprouts by pruning.

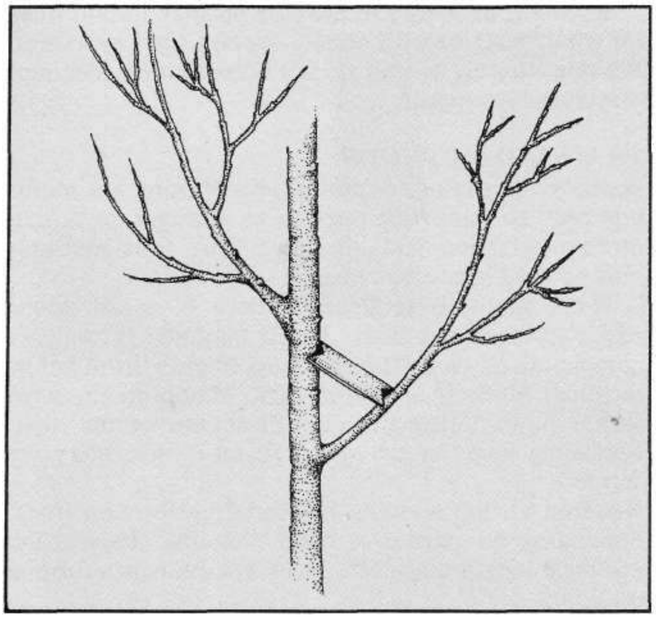
Spreading—Spreading young shoots in the first or second season of growth creates wide crotch angles. Wide crotch angles are structurally stronger than narrow angles. As limbs grow and thicken, wide-angled crotches develop strong supporting wood. Narrow-angled crotches develop bark *inclusions.* Inclusions are weak or damaged areas covered by callus growth.

Wide-angled crotches reduce the chance of limb breakage, especially when limbs carry a heavy load of fruit. In cold Northern climates, strong crotches support snow and ice better. Narrow-angled crotches with bark inclusions break apart when ice forming in them expands.

Tying-Out—This method is used in conjunction with bending and spreading. Tying-out involves tying branches into desired positions. Branches can be tied down with ropes or wire cable to help develop wider crotch angles. Branches can be tied to the central leader to help support them.

Pruning—Pruning is used as little as possible for training purposes. Pruning reduces tree size and delays onset of production. For best results, use pruning moderately in conjunction with spreading.

Spread trees first, then determine which limbs to keep and which limbs to remove. In spring, pinch back poorly placed shoots when they have made only a few inches of growth. Pinching poorly placed shoots directs the energy of trees into usable scaffold branches. Don't remove unwanted shoots entirely, just pinch back to discourage growth.



Use simple wooden spreaders to bend young branches outward during training of young fruit trees. Cut a V-shape in each end of a short piece of 1x4 lumber, or drive nails in the ends of boards. Clip off the nail heads to form sharp points. The sharp points will hold spreader boards in position.

Because midsummer pruning has a dwarfing effect, it is not used for training trees. Dormant-season pruning plays the major role in training.

TRAINING SYSTEMS

Different training systems have been developed to fit various plants and situations. Some systems are simple and easy; others are more difficult.

Vase **or Multiple Leader—**This system is widely used by commercial orchardists. The mature tree assumes a vase shape if properly trained.

Head the tree between 18 and 30 inches above ground at planting. During the first dormant season, select three or four lateral shoots to develop as primary scaffold limbs. Scaffold limbs should originate about 1 or 2 feet above ground level and be evenly spaced around the trunk. The height of limbs remains at the same point above the ground throughout the tree's life. Make sure there is enough space between young shoots to grow without pressing on one another.

The vertical distance between primary scaffold limbs should vary 6 to 8 inches for the tree to be structurally strong. Too little vertical distance between primary scaffold limbs is a common weakness of vase training.

Primary scaffold limbs should be unequal in length and thickness. Equal forks and branches are structurally weak. Prune hard on the most vigorous limb to balance it with the others.

Three or four primary scaffolds are enough. More scaffolds results in a tree with an excessive spread and weak, unproductive branches. Scaffold limbs do not bear fruit. Only *fine wood* is productive. Fine wood is small-diameter, young wood that develops on secondary and terfiary scaffold limbs.

During the second dormant season select three or four secondary scaffold limbs 12 to 18 inches above the primary scaffold limbs.

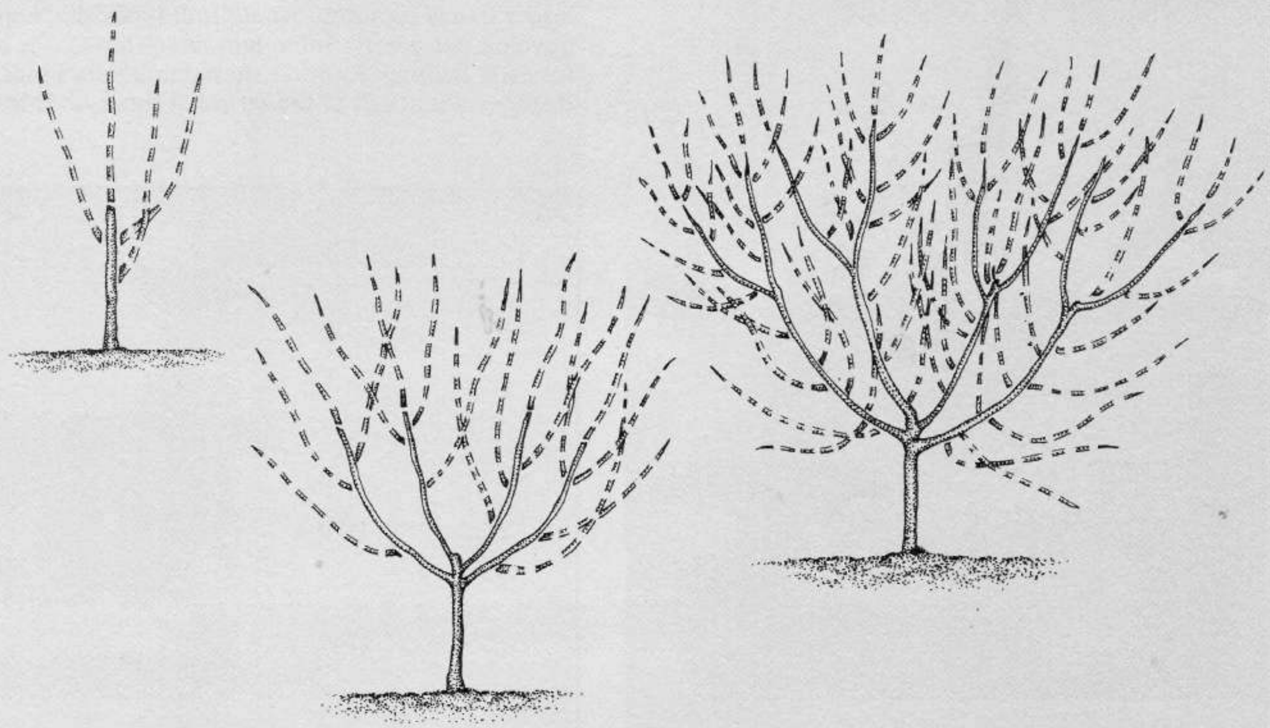
If there are too many scaffold limbs, fine wood develops at branch tips, instead of near the trunk. Each scaffold limb will be smaller and weaker. Heavy loads of fruit will grow near the end and limbs will spread excessively outward. An ideal vase-trained tree spreads little under the weight of a heavy fruit crop.

One problem with vase or multiple-leader training is easy to see in naturally upright trees. Leaders tend to close in on one another in the center. To correct this condition, place limb spreaders between primary scaffold limbs when limbs are flexible enough to bend. Bend scaffold limbs about 20° to 30° from vertical to open the tree's center.

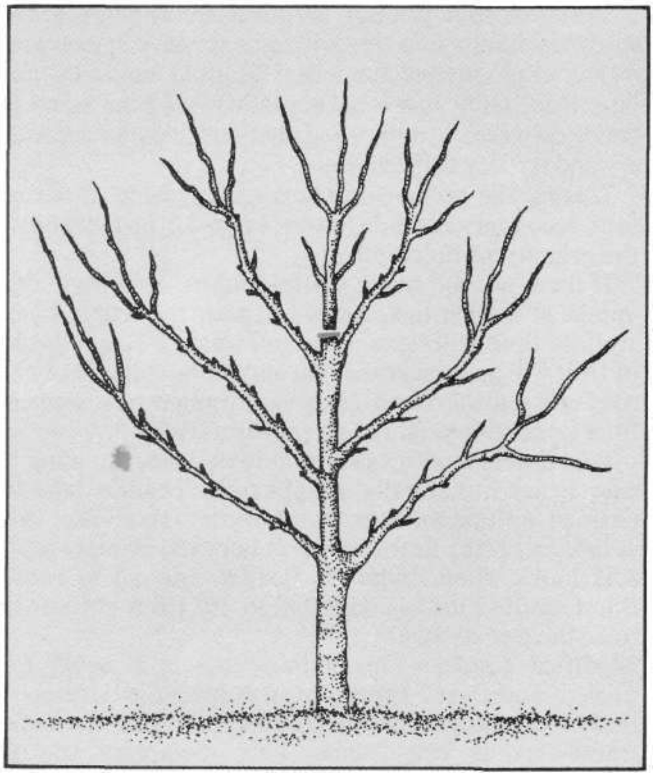
Modified Leader—This training system is better for upright and closed-center trees. A leader is developed from a central axis and is kept in place until the basic framework is established. This temporary central leader helps develop well-spaced, wide-angle scaffold limbs.

If necessary, scaffold limbs are spread with boards

TRAINING A VASE-SHAPED TREE



Left: At planting time all limbs are pruned to short stubs. Head the tree about 18 to 30 inches above ground. Center: Select three or four permanent scaffold limbs in the first dormant season. Remove all other limbs. Scaffold limbs remain at the same height throughout the life of the tree. Right: During the second dormant season select three or four secondary scaffold limbs 12 to 18 inches above the primary scaffolds. Training this way forms the basic vase shape.



In the modified-leader system, the central leader is removed after main scaffold limbs have formed.

Central-leader trees, such as this 'Red Delicious' apple, tend to grow into upright, columnar trees. You can counteract that tendency by placing small boards or spreaders between branches, forcing the branches to grow apart.

placed against the central axis. Later, the central leader is pruned back to a lateral. This seldom-used method takes longer and requires more pruning than the vase system. The end result produces a tree similar to the vase system.

Central Leader—Central-leader training will develop a framework for a tall, narrow tree. A conical shape is produced for efficient utilization of light. Central-leader training avoids most problems caused by tree spreading.

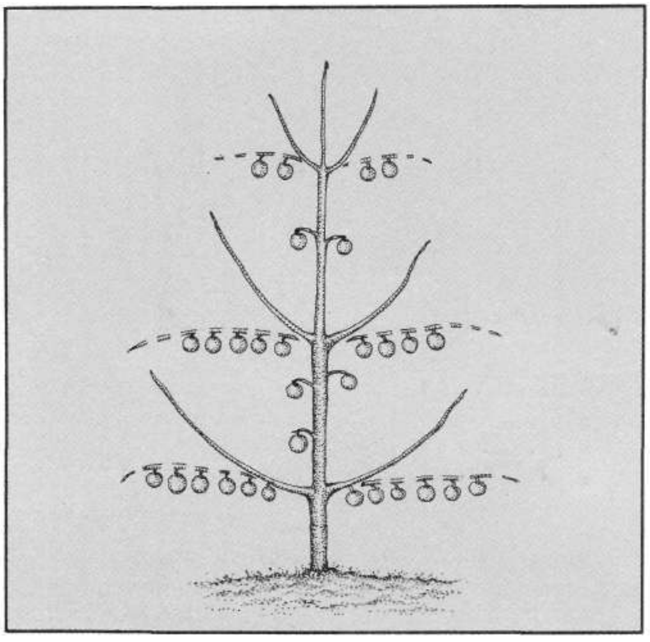
Central-leader training is easier with certain species of trees than with others. This method is especially useful with dwarf and semidwarf trees because harvesting is easier with smaller trees. Central-leader training is not recommended for large trees. It is difficult to reach the center of a tree when the center is 10 feet or more above ground.

To develop a central-leader tree, remove or spread competing shoots to establish the dominant position of the central leader. This is best done in the summer following planting.

Each year during the dormant season, head the central leader 2 or 3 feet above the lower whorl of branches. The ideal distance between whorls of branches is related to the distance branches must spread. The larger the tree, the greater the spread and distance required between the branches.

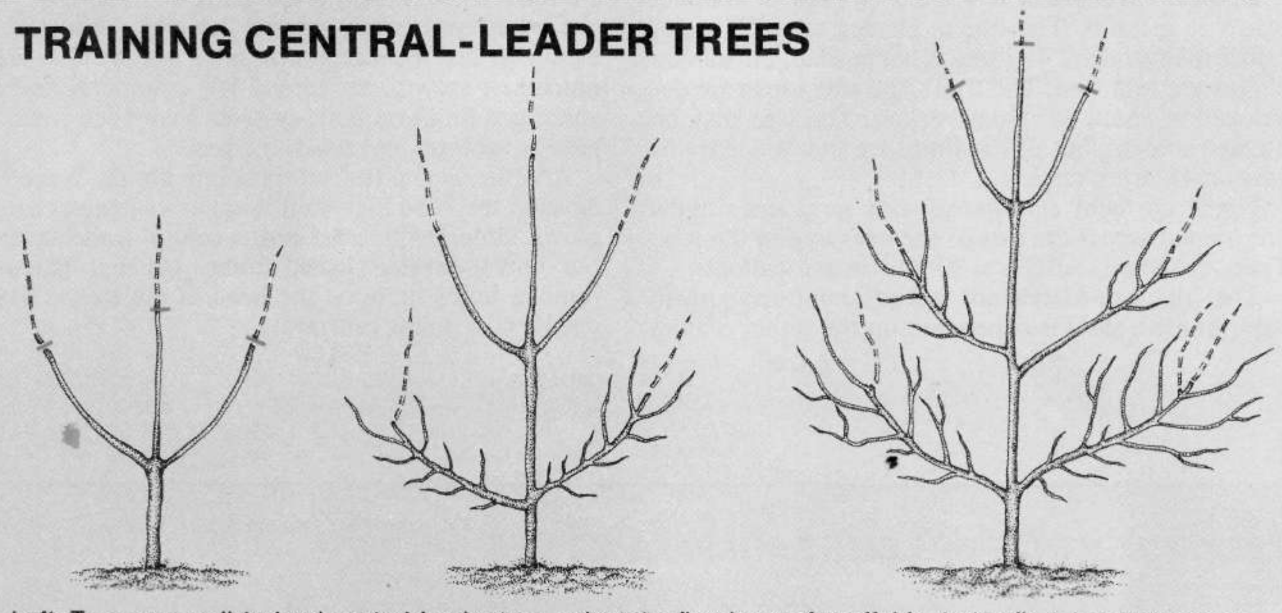
Before pruning, use wooden spreaders to hold limbs 45° to 60° from vertical. Some central-leader fruit trees do not need limb spreading because side limbs naturally form wide angles.

Spreaders can be moved to higher limbs the following year. Remove spreaders in midsummer. Three main whorls of branches on a 12-foot-high central-leader tree is common. About four to six side branches develop per whorl. Some temporary limbs can be left for early fruiting. Remove these temporary limbs later. Remove about 1/3 of the terminal shoot on side limbs



Limbs of a central-leader-trainea tree won't spread far off center with weight of crop.

TRAINING CENTRAL-LEADER TREES



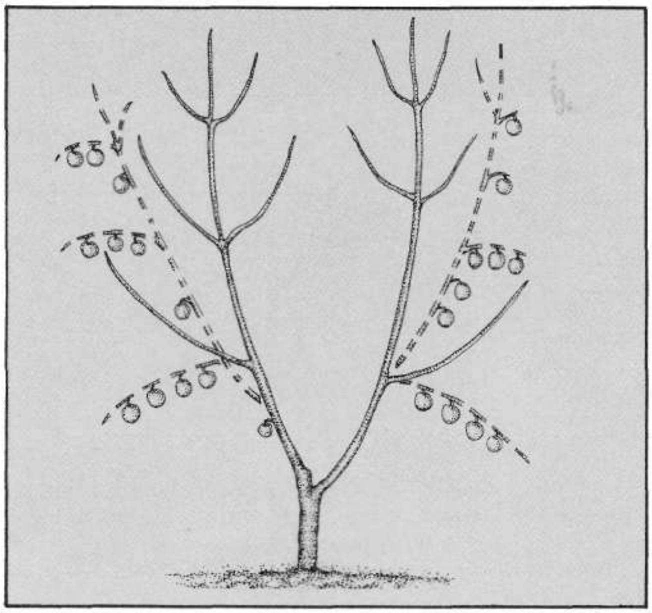
Left: To grow a well-trained central-leader tree, select the first layer of scaffolds during first dormant season. Install spreaders and head scaffolds to stimulate branching. Center: During third or fourth dormant season, install longer spreaders on the lower branches. Develop and prune the second tier of limbs the same as the first tier. Right: During fourth or fifth dormant season, prune higher branches the same as lower tiers.

each year. Head to outward-pointing buds on varieties that do not branch well.

Remove water sprouts growing on upper sides of spread limbs. The presence of water sprouts indicates limbs are spread too far apart.

Remove all fruit from the upper 1/3 of the central leader. If fruit is not removed, the leader bends to the side and growth stops.

Trellis Training—There are many ways to train a tree to a trellis. The trellis may be constructed against a wall or fence, or between posts. Usually a trellis has three or four wires strung horizontally and spaced 2 or 3 feet apart vertically. The tree is trained onto the trellis while shoots are limber.



Limbs or a multiple-leaaer-trained tree spread wide under the weight of a heavy crop.

Numerous methods are used to fasten limbs to the trellis, including wire staples, cloth strips, masking tape and twine. Avoid using ties made of materials that could injure growing limbs. Ordinary masking tape is good for flexible shoots because it does not need to be removed to prevent damage to limbs. Large, U-shaped wire staples are useful for permanently fastening limbs large enough to hold staples. The limb grafts itself to the wire where staples are attached.

Horizontal Espalier training requires heavy pruning to control shoots on top of horizontal limbs. Create a horizontal espalier by heading the central leader just below the lowest wire. This will develop two horizontal shoots and one vertical shoot. Spread the two lower shoots horizontally along the wire. As the horizontal shoots grow, continue attaching them to the wire. As the vertical central leader grows to the next horizontal wire, head below that wire, and repeat the process.

Baldessari Palmettes are developed by heading the tree 4 to 6 inches below the first wire. Use the uppermost shoot for the central leader and the next two lower shoots to form side limbs at an angle of about 45°. As the tree grows, head the leader just below the next wire. Repeat the procedure at each wire level until the top wire is reached. Pinch back or remove all other shoots. Don't head side limbs of the palmette. See the illustration on page 62.

A simple variation of the palmette involves developing only two limbs in a V-shape. This is done with some trees such as peaches. Training in a V-shape can be done without a trellis.

If shoots are cut or pinched back in summer, flower buds may form at the next bud below the cut. This happens only when shoots are in a certain stage of development. The best time for pruning varies among species and varieties. If you can determine the right time to pinch back shoots arising from horizontal espaliers, flower bud formation is stimulated.

Drapeau Marchand is another system of training plants to a trellis. The tree is planted at a 45° angle, rather than straight. The tree is not headed, but all side shoots are removed. The trunk and side limbs are developed at about 45° from vertical. The tree may be planted straight, but all side limbs are attached to trellis wires at 45° from vertical.

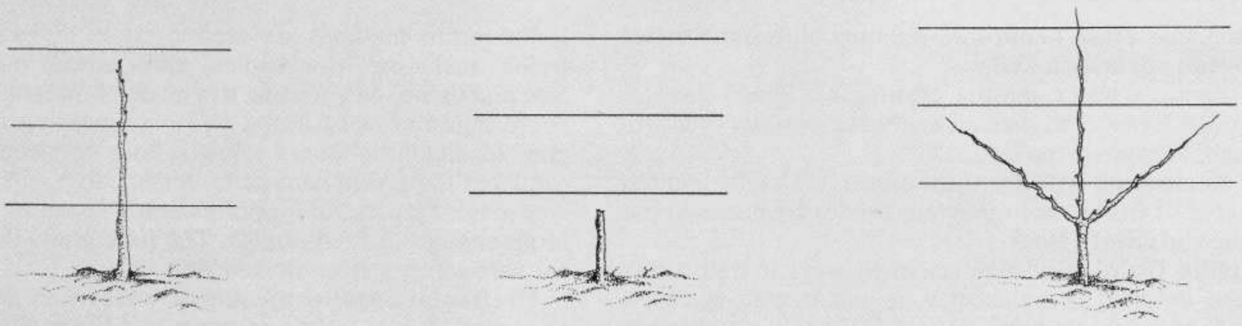
Limbs are bent and spread with spreaders. Limbs are trained across the axis of the next tree in the row. Train secondary scaffolds at 90° to primary scaffolds.

The drapeau-Marchand system controls growth well, but the plant is dependent on the trellis. Staples are used to hold limbs permanently to the wires.

Cordon systems are started the same as horizontal espaliers, but the side limbs, after a short distance of horizontal growth, are turned 90° upward. Numerous variations on these basic systems have been tried. All have advantages and disadvantages.

Another way to fit fruit trees into limited space is to develop the head high so flowers or vegetables can be grown underneath. Start with a central-leader system, but don't develop lower limbs. Instead, gradually remove lower limbs as the head of the tree is developed higher on the central axis.

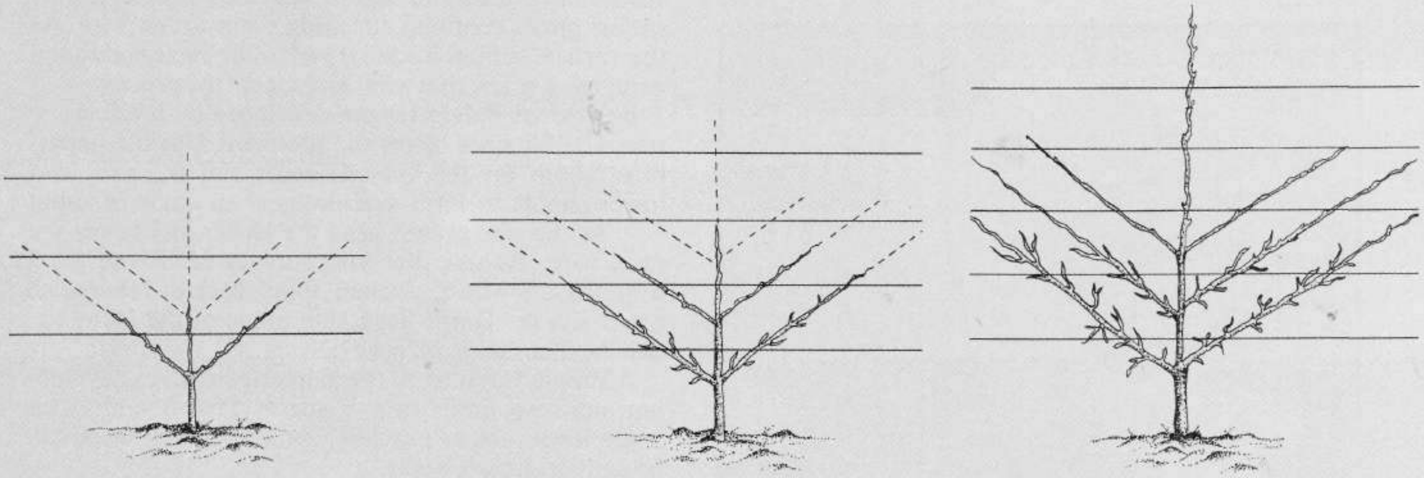
DEVELOPMENT OF BALDESSARI PALMETTES



1. Allow young fruit tree to grow 12 to 18 inches tall during first season.

2. Head central leader of young tree 4 to 6 inches below first support wire.

3. As first scaffold limbs develop, attach limbs to lowest wire with ties.



4. As tree grows, head central leader just below second wire. Pinch back first scaffold limbs and develop second set of scaffold limbs.

5. Continue heading and pinching process at each wire level until the top wire is reached.

6. Pinch back all leaders to encourage growth of fruiting wood for fruit production.

SUPPORTING FRUIT TREES

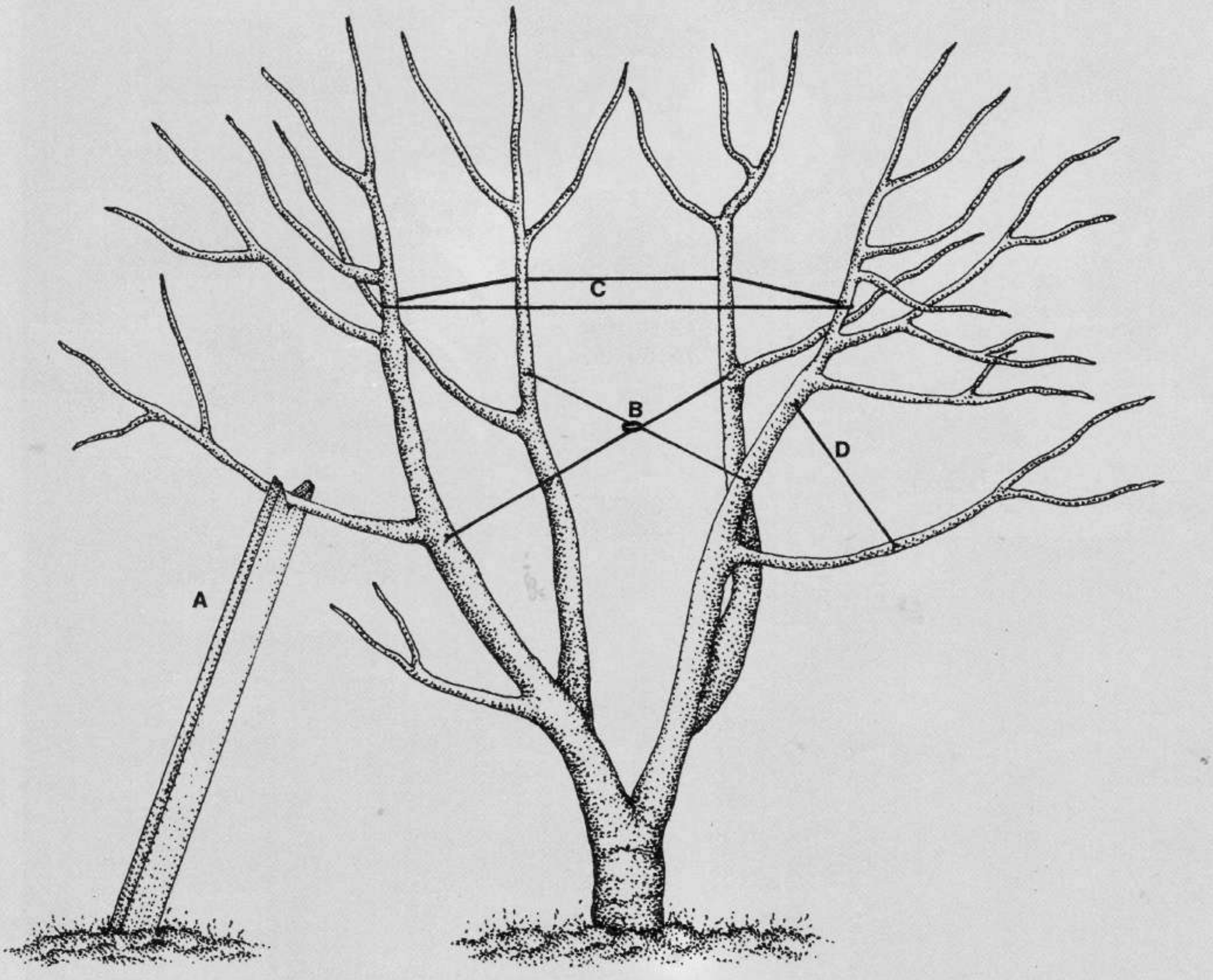
Weak scaffold limbs with too-wide or too-narrow crotch angles can sometimes be corrected by radical tree surgery. In an extremely old and weakened tree, there is nothing to do but hope for the best. No amount of pruning will correct advanced age or deterioration of a tree. Weak scaffold systems can be held together by wiring a strap around the outside of the limbs.

The tree can be used to support heavy or weak scaffold limbs by twisting water sprouts together from nearby scaffold limbs. The water sprouts become grafted to one another, forming a living bridge of support. If too many scaffold limbs are found in a young tree, remove one limb per year.

Wind—Wind is a complicating factor in tree training. To support a tree in windy locations, angle a stake into the ground downwind from the tree. Tie the trunk and any major limbs on the windward side to the stake with loose ties. If the site is extremely windy, a trellis system may be the best solution. Wind can make it almost impossible to grow some varieties of fruit.

TREE SUPPORT SYSTEMS

Here are several different effective support systems used for fruit trees. Using these methods can prevent breakage from heavy crops in young fruit trees and help support older trees.



A. Limb props made from old 1x4 or 2x4 lumber with notched ends.
B. Center wiring uses screw eyes in limbs and a washer between wires.
C. Straps or wire placed around the outside of main scaffolds.
D. Limbs tied up with wire and screw eyes in limbs.

Bearing Trees

Pruning for training should be completed in three to five years. Although it is important to remember training goals, pruning has other objectives.

The prime purpose of pruning a bearing tree is to renew fruiting wood. Another purpose is to reduce the need to support fruit-laden branches. Prune a young bearing tree as little as possible so crop production is not reduced. Lightly pruned peach trees produce twice as much fruit as heavily pruned trees. Unpruned peach trees will soon stop producing. Peach trees bear only on wood that grew the previous season. This is not true for trees that bear on long-lived spurs.

Pruning is necessary to keep trees accessible for spraying thinning and harvesting. Tree height must be limited and openings made for ladders. Foliage must be thinned so chemical sprays penetrate and coat foliage and branches. This is especially important to control scale insects and spider mites. Pruning also helps maintain good-quality fruit.

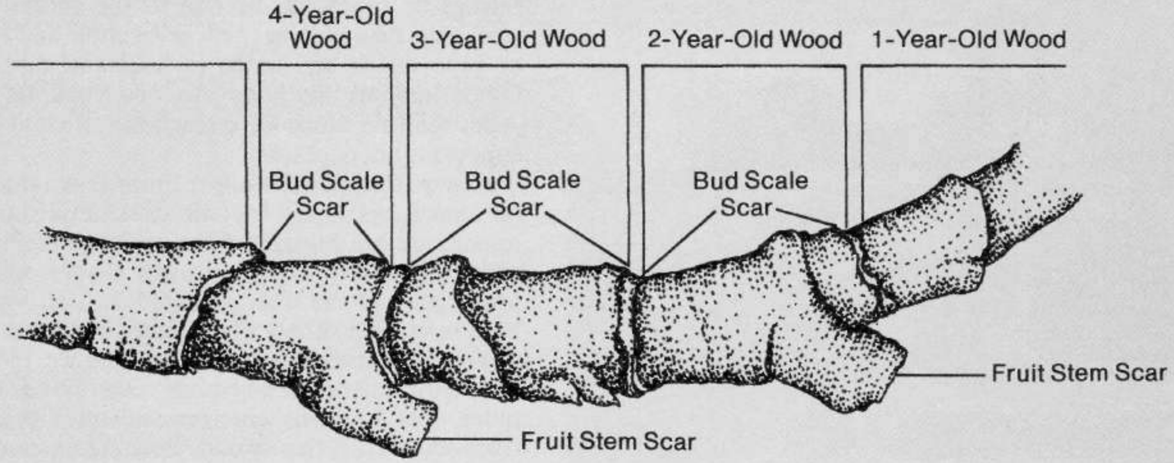
Determining Age—You can determine the age of any portion of a branch up to 4 or 5 years old by counting rings of bud-scale scars back from the terminal shoot. Counting rings is more difficult with trees that branch frequently. The distance between rings of bud-scale scars tells the years the tree grew well and years of poor growth.

Bearing Habit—This refers to position and age of wood that carries fruit. Fruit is borne on current-season's wood, last-season's wood, long-lived spurs or on a combination of shoots and spurs.

Plum blossoms are among the first to bloom in spring. Knowing the flowering time of fruit trees helps you learn the location of fruiting wood. Fruiting wood helps you determine the location of pruning cuts.

DETERMINING AGE OF FRUIT TREES

Determine the age of fruit trees by counting the rings of bud scale scars. By examining stems of this fruit tree you can see that it bore fruit every other year. This means most of the flower spurs rested, with little or no fruit borne on them during the first year. The spurs produced a lot of fruit the following year. The rest of the flower spurs produced a small amount of fruit, and these spurs will not bear fruit the following year.



Fruit-bearing wood is positioned terminally, laterally or both. See the table below for fruiting habits of various fruit trees. Bearing habit influences the number and kind of pruning cuts.

Species that fruit only on current-season's or previous-season's growth require more pruning than trees that fruit on spurs. More pruning is required to renew fruiting wood on trees that bear on short-lived spurs. See pruning of individual species for details.

Pruning to Increase Fruit—Deciduous fruit trees differentiate flower buds from leaf buds the year before the spring when these buds open, bloom and set fruit. In midwinter, flower buds are easily distinguished from leaf buds. Flower buds are larger and rounder than leaf buds. Normally, more flower buds are produced than are needed for a good crop.

Pruning helps improve fruit size by reducing the number of fruit-setting flower buds. Some fruit trees produce few or no flower buds during the year when trees bear a crop. These are alternate-bearing trees that bear fruit every other year. Pruning heavier in winters with abundant flower buds promotes more regular bloom and bearing. Fruit-thinning early in the growing season encourages trees to bear consistently.

FRUITING HABITS OF COMMON FRUIT AND NUTS

This chart shows the position on the branch where fruit will be borne and the type and age of wood that bears fruit.

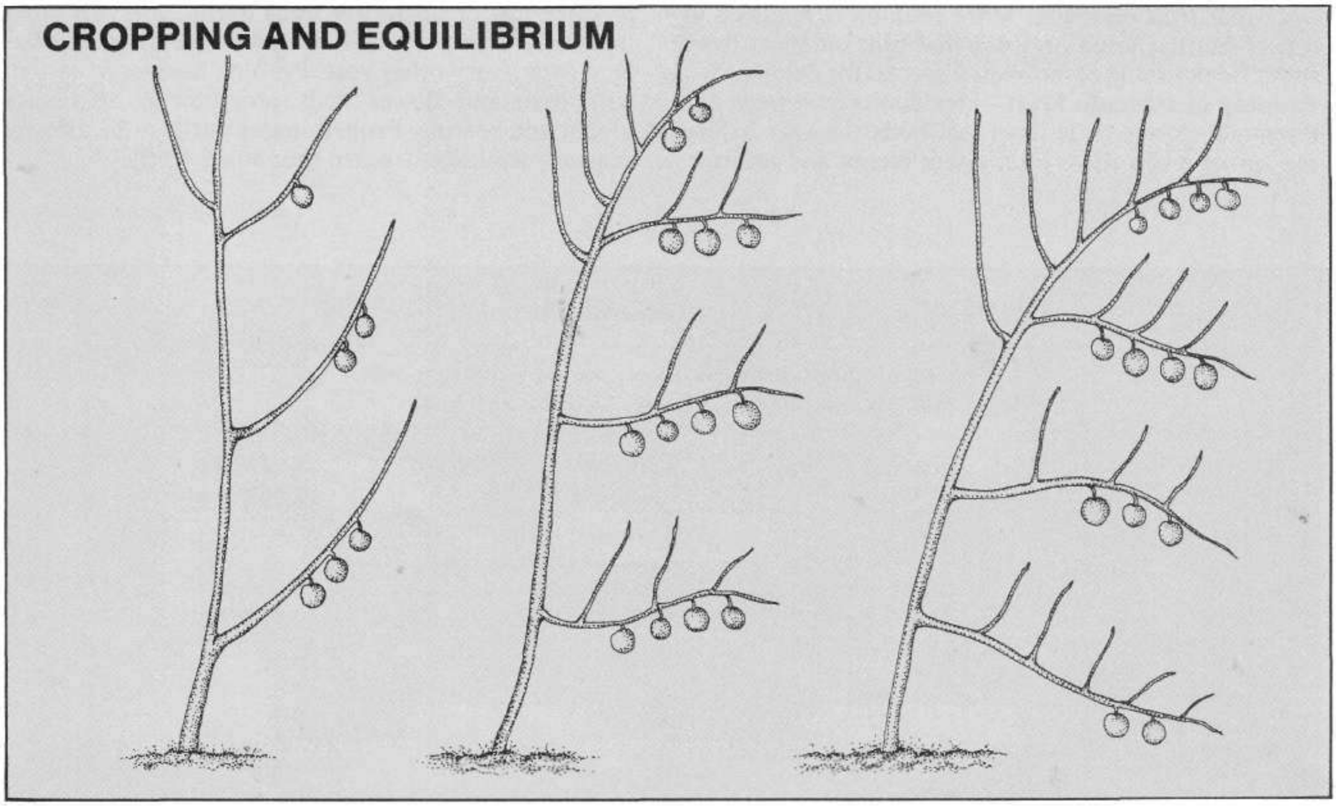
Current-Season's Shoots	Previous-Season's Shoots	Previous-Season's Spurs and Shoots	Long-lived Spurs
Fig—second crop	Avocado	Apple—minor	Almond
Grape	Blackberry	Cherry, sour	Apple
Lemon	Black Currant	Gooseberry	Apricot—short-lived spur
Orange	Black Raspberry	Pear—minor	Blueberry
Persimmon	Fig—first crop	Pomegranate	Cherry, sour
Quince	Filbert	Red Currant	Cherry, sweet
Raspberry—ever-bearing	Nectarine	White Currant	Pear
Walnut	Olive		Pecan
	Peach		Plum, European
	Pistachio		Plum, Japanese
	Quince		Pomegranate

This mature peach tree has been well-trained and pruned. It will require little support to carry a heavy crop.

Supporting Heavy Crops—The growth rate of trees usually slows considerably after trees begin to produce heavy crops. Even if trees are well-trained and properly pruned, the first few crops often bend or break limbs. Prevent limb breakage by stringing a light rope or flexible wire around scaffold limbs about 2/3 of the way up the tree. Hold ropes in place by tying them to limbs. Strings or ropes can be tied to the central leader of trees. Or, tie a pole in the tree's center and run strings or rope out to the limbs to hold and support them. Other support methods are described on page 63. After scaffold limbs have reached sufficient thickness, support is not necessary.

Heavy fruiting pulls upper limbs down into horizontal angles. As limbs become horizontal, buds on the upper side are released from apical dominance. Long water sprouts form. Top-growth shades and weakens lower parts of the tree. To avoid this, cut upper limbs back to upright shoots where limbs arch over.

Young bearing trees tend to produce more shoots than fruit during fruit-bearing years. But as trees grow older, this gradually changes and trees begin to produce more fruit than wood. Pruning encourages trees to produce more wood and less fruit. Avoid excessive pruning of young trees that are slow to set fruit. Prune vigorous young trees by thinning, with little or no heading. If early heavy fruiting has stunted tree growth, stimulate growth by making many heading cuts.



This illustration shows how heavy cropping affects equilibrium. As limbs bend under the load of fruit, apical dominance is lost. Water sprouts appear. Use of the leader-renewal system and tree supports will counteract this effect. See opposite page for more information on establishing renewal leaders.

SUMMER PRUNING

Summer pruning of vigorous young trees reduces tree vigor, but does not interfere with flower-bud formation. Pruning during or soon after bloom stimulates as much regrowth as dormant pruning. Later summer pruning creates a dwarfing effect up to the time when shoot growth stops.

Early summer to midsummer heading or pinching of shoots promotes branching. Regrowth after pinching is often too thin, weak and parallel to be useful fruiting wood. Pinching is essential to control growth with some espaliers.

Heading current-season shoots on apples and leaving a 1/4-inch stub at the base ensures regrowth from less-well-developed buds near the shoot base. Regrowth from theft buds is weak, and vigor is controlled. Excess vigor in the tops of young trees can be controlled by summer pruning.

Pruning from midsummer to late summer delays acclimation of trees to fall cold. Pruning at this time increases vulnerability to an early freeze. Don't prune trees in fall, especially if winter cold threatens. Summer pruning slightly increases the amount of chilling required to ensure normal leafing-out in spring. This factor is important in areas with warm winters. Although summer pruning of young bearing trees has some useful applications, most pruning of young trees is best accomplished during the dormant season.

DORMANT PRUNING

When trees are dormant, it is easier to see the amount of new growth and distinguish scaffold-limb structure.

Start by pruning a ladder bay. This is an area in the tree's center that allows access for ladders, with room for you to work. Set the ladder and climb to the highest point you wish to work.

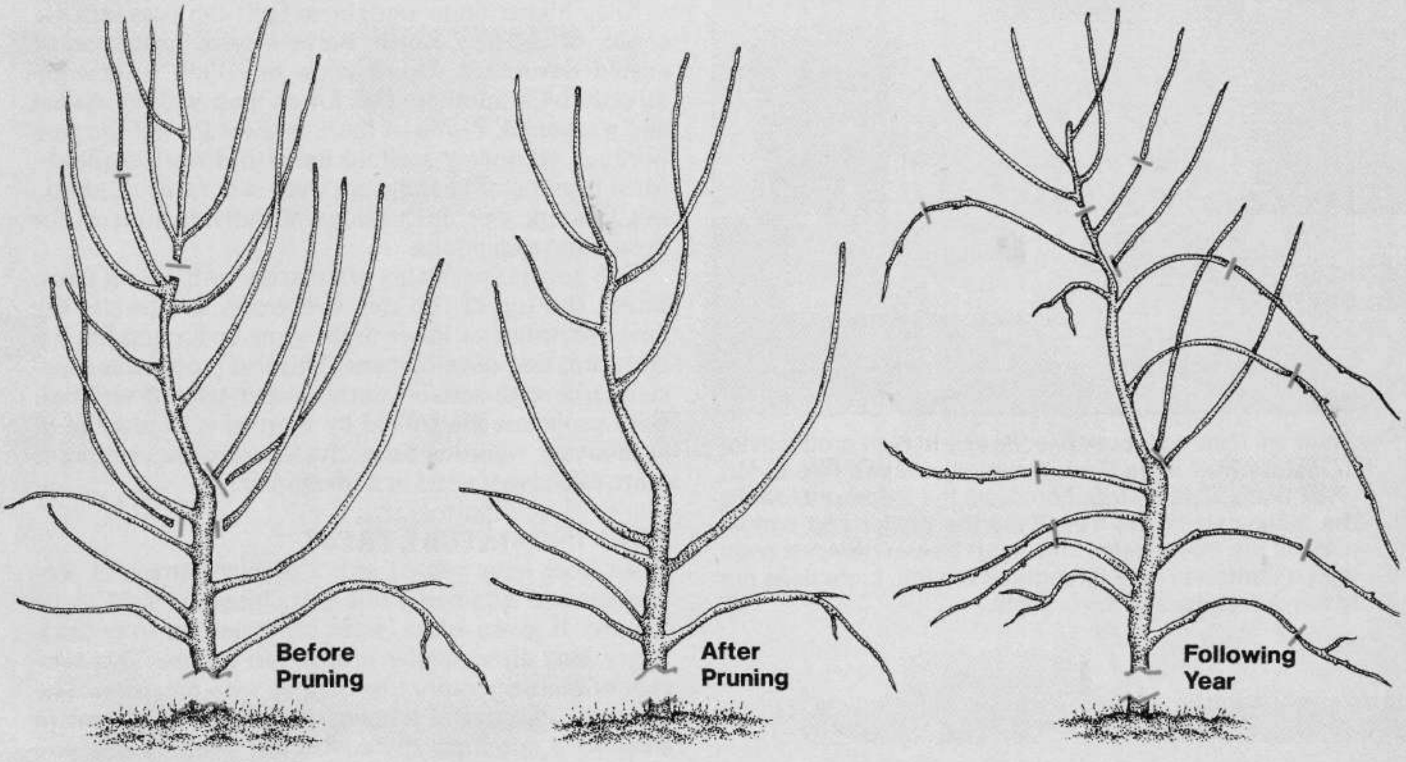
Establish the permanent renewal point for each leader at a place that can be easily reached with your loppers. See below for information establishing renewal points. Select a single vertical shoot and head it. Remove all other shoots above or around the vertical shoot. The headed shoot that forms at the renewal point is now the highest point on the leader. The growing tips of these leaders will hormonally suppress growth of shoots below.

Descend through the tree, thinning shoots and leaving shoots needed for renewal of fruiting wood. Prune hardest in upper, outermost parts of the tree. Thin to an outward-headed terminal shoot where more spreading is needed. Thin to a more upright shoot where spreading isn't needed. Most productive wood tends to migrate upward and outward away from the trunk. This is due to a tendency for the greatest growth in well-lighted parts of the tree and for fruit weight to spread the tree.

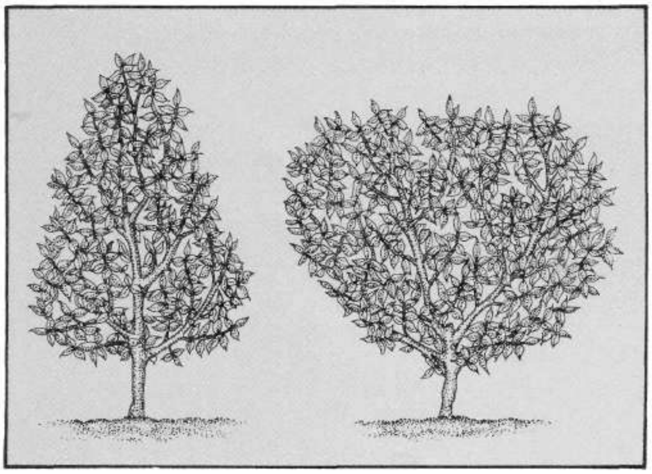
This trend is counteracted by maintenance of a series of renewal leaders. As the secondary scaffold

ESTABLISHING RENEWAL POINT

To establish a renewal point, thin the central leader to a single upright shoot with a few scaffold limbs and then head it. Repeat this procedure the following season, always moving up or down the terminal leader a few inches. The renewal point can be re-established each year with three or four cuts.



Low, wide-spreading brancnes are the Key to successful training of peach ana nectarine trees. Developing two or three primary scaffolds in a Y-configuration saves space and makes harvesting easier.



Optimum light distribution is the key to high productivity in mature fruit trees. The pyramidal-shaped tree at left gives better light distribution down the sides and toward the inner part of the tree. Only the center and bottom parts of the tree receive little light. Tree at right has good light distribution only throughout the top. Light does not reach the center and lower parts.

bends down, remove the old leader that has become nearly horizontal.

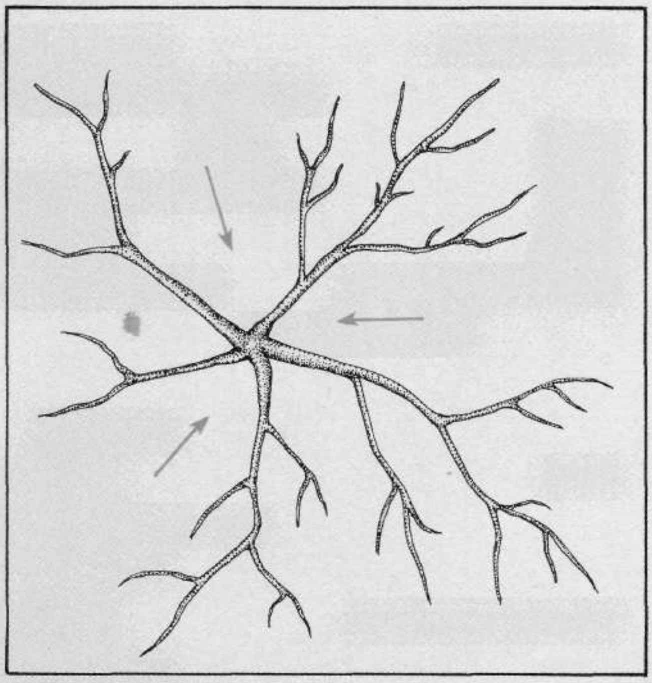
Keep higher limbs upright so light can pass into the center of the tree. Lower limbs may be horizontal or angled downward. Don't allow one limb to develop directly over another. The lower limb will be shaded and weakened. Prune so there is space for light to pass between secondary-scaffold limbs and main scaffolds. Most pruning of bearing-age trees is done by thinning, not heading. See descriptions of individual plants for details and exceptions.

Two general problems often arise with young trees. Either the top of the tree overgrows and dwarfs the lower portions, or lower limbs grow up around the top and stunt tree development. This last problem is especially true with certain central-leader-trained varieties. Both problems are solved by more severe pruning of excessively vigorous parts. Such corrective pruning is more effective if done in midsummer.

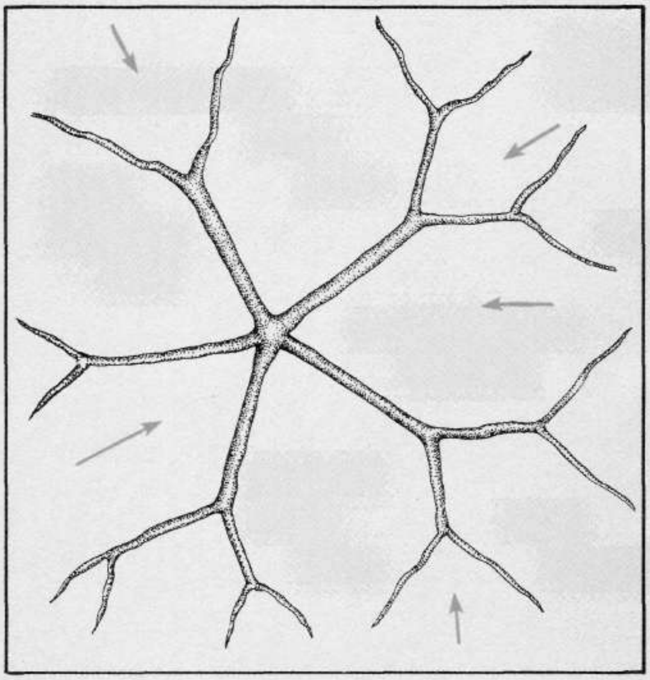
PRUNING MATURE TREES

Once trees have settled into a regular pattern of production and attained adult size, trees are said to be mature. If given space, trees can continue to become larger long after regular production begins. This concept of maturity cannot be defined with precision. The principal objective of pruning mature trees is to contain trees in a specified space. Regular pruning lets you reach the tops of trees from the top of a ladder. If the

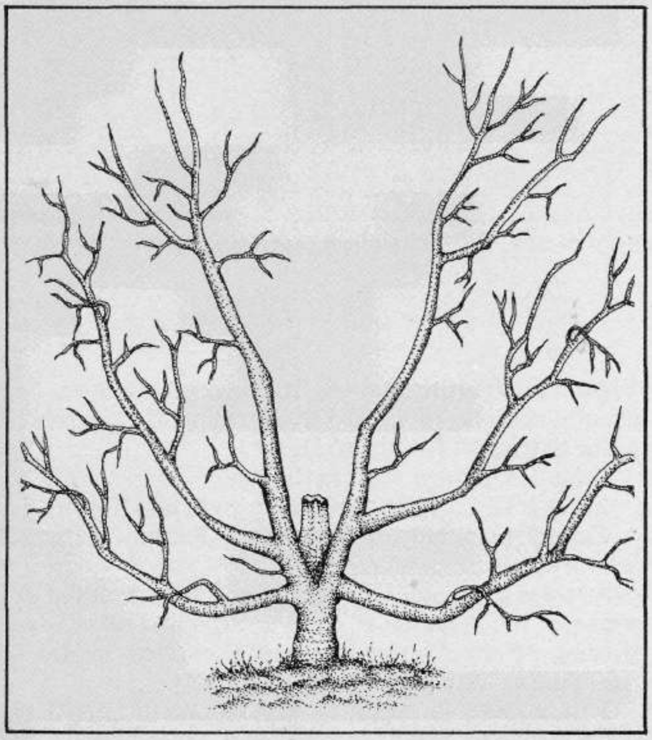
HOW PRUNING IMPROVES LIGHT DISTRIBUTION



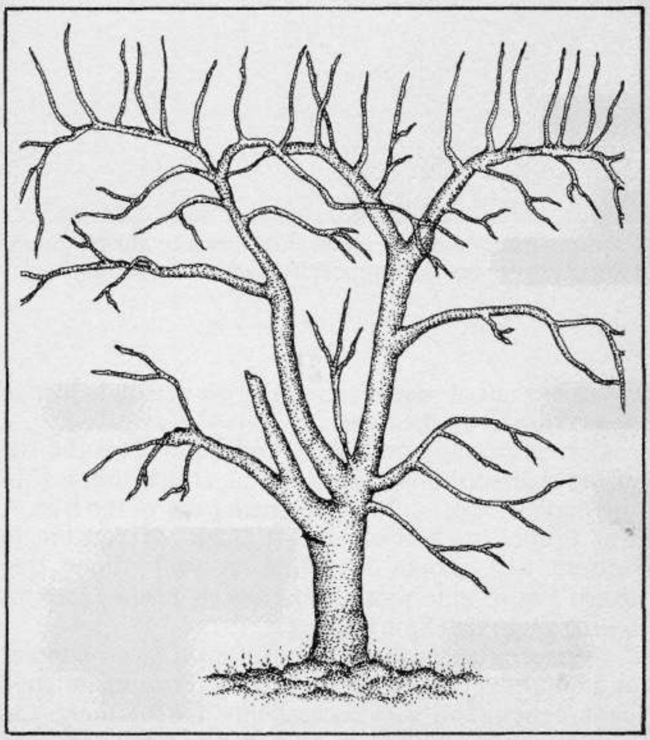
Bird's-eye view down on a tree pruned without equal forks shows how light easily penetrates into the tree's center. Light penetration improves growth and fruit production.



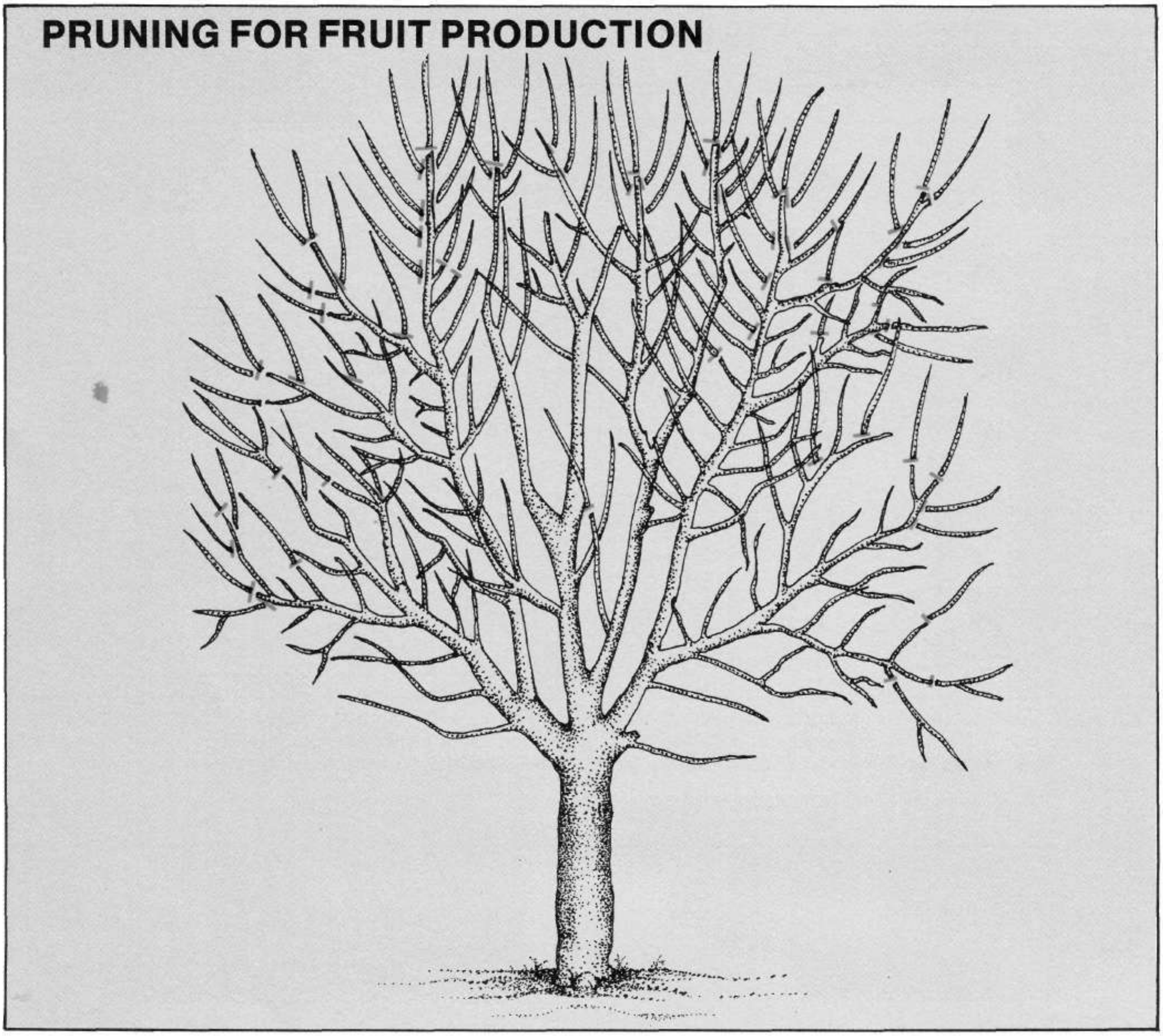
Same view of another tree pruned with too many equal forks. Light penetration is blocked. Result is poor fruit production and eventual death of interior growth.



Pruning improves light distribution throughout this tree. Upright limbs do not shade the lower limbs.



Horizontal limbs in the top of unpruned tree block light before it can reach lower limbs. Growth is sparse.



Prune hardest in upper, outermost limbs to allow light into interior of tree. This keeps fruit producing on heavier wood. Larger branches can support fruit without bending.

tops grow out of reach, you either get a taller ladder or lose control over the trees.

Correct pruning promotes production from the top of the tree all the way down to the crotch, not just in the highest, most difficult-to-reach parts of the tree. A tree pruned to bear all over will be covered top to bottom with bloom in spring. A well-pruned tree doesn't need limb props that a poorly pruned tree requires to prevent limb breakage.

Correct pruning increases fruit size, sugar content and improves color and skin texture. Pruning for good light penetration and accessibility for thinning and picking improves disease and insect control because the sprays penetrate better. Correct pruning does require a lot of time. A large apple or pear tree may require 1 to 3 hours of detailed work. The time is well spent if you value the tree's beauty and the quantity and quality of fruit.

Vigor And Fruiting Zones—In large, mature trees it is usually possible to discern three main zones in regard to the balance of fruiting to vigor:

Zone 1: Greatest vigor in the top.

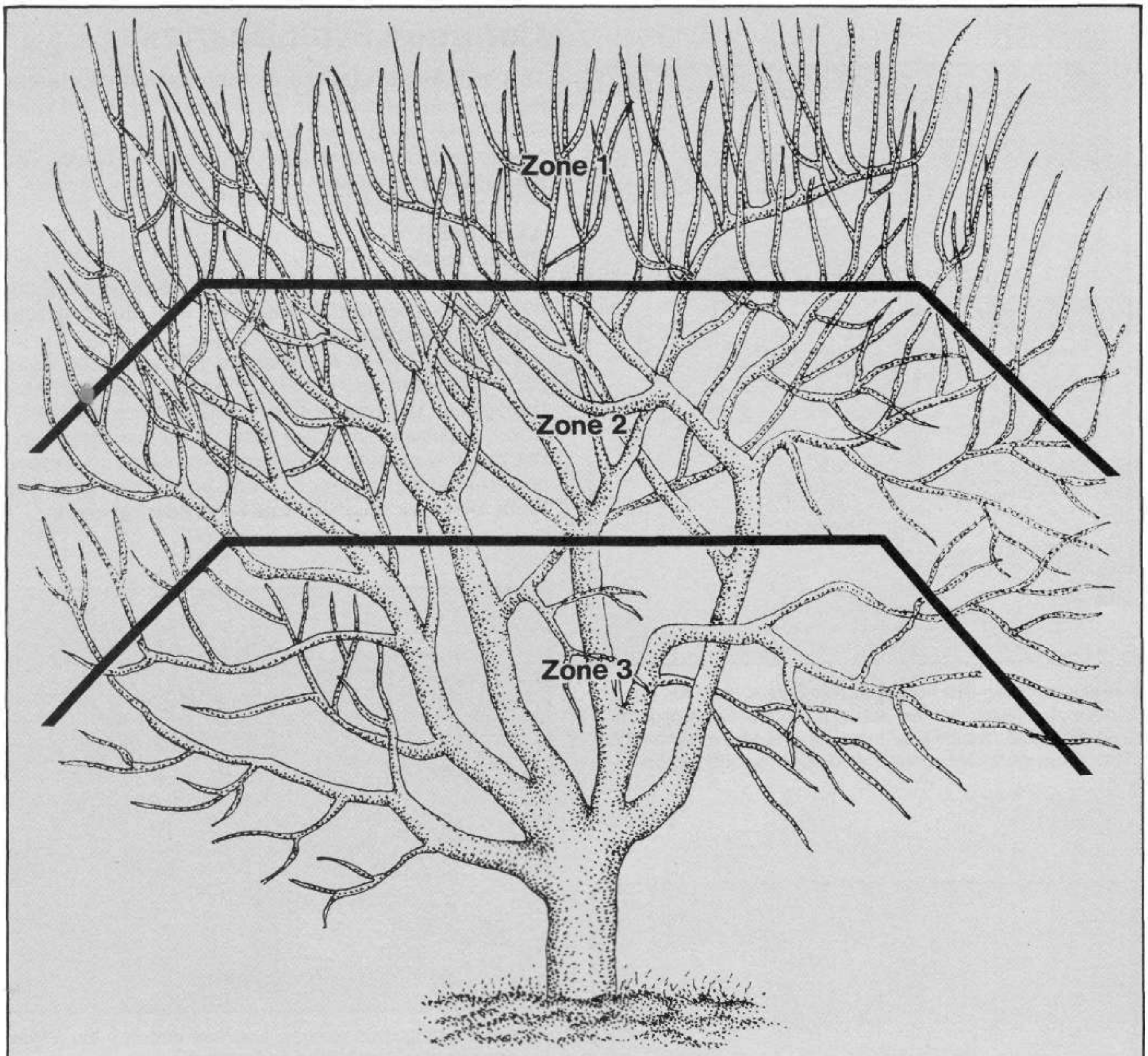
Zone 2: Good balance between vigor and fruiting.

Zone 3: Generally low in vigor. Blooms well, but sets few fruit.

As trees grow older, Zones 1 and 3 enlarge at the expense of the more ideal Zone 2. Principal reasons are shading of lower limbs by upper limbs and weight of fruit pulling limbs off-center.

Pruning hard in upper, outermost part of trees helps counteract this trend. As trees age, upper limbs grow thicker and tend to produce longer shoots. Occasional saw cuts are needed to keep heavy wood out of treetops. Heavy, horizontal wood should not be allowed to develop in treetops.

As trees grow older and limbs stiffen, the need for



In Zone 1, shoot growth occurs at the expense of fruiting. In Zone 2, a good balance between fruiting and growth exists. Zone 2 produces high-quality fruit. Zone 3 is shaded and weak, lacking vigor and producing poor-quality fruit.

replacement leaders diminishes. It is important to maintain the upright angles of higher limbs.

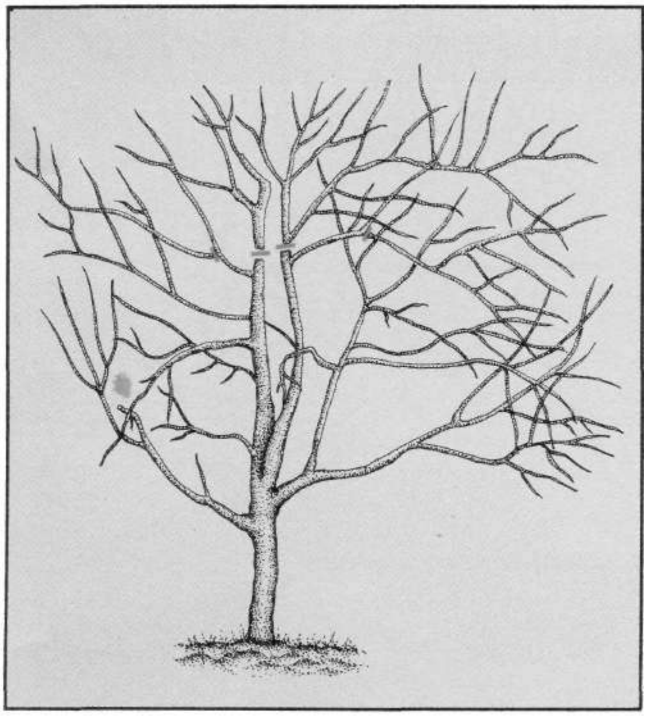
The overall shape of the fruit trees should be conical or trapezoidal. The widest part should be at the base and the tree should taper inward toward the top. Unless upper limbs are pruned to be shorter than lower ones, this shape relationship is quickly reversed.

Remove long water sprouts and suckers during summer. Well-pruned trees have few suckers because apical dominance has been maintained. Water sprouts can be entwined limb to limb to form a living brace. Tying water sprouts together strengthens the internal limb structure of trees. If water sprouts are bent over and tucked under a spur or other limb, they usually form a flowering spur. This increases productivity of that part of the tree.

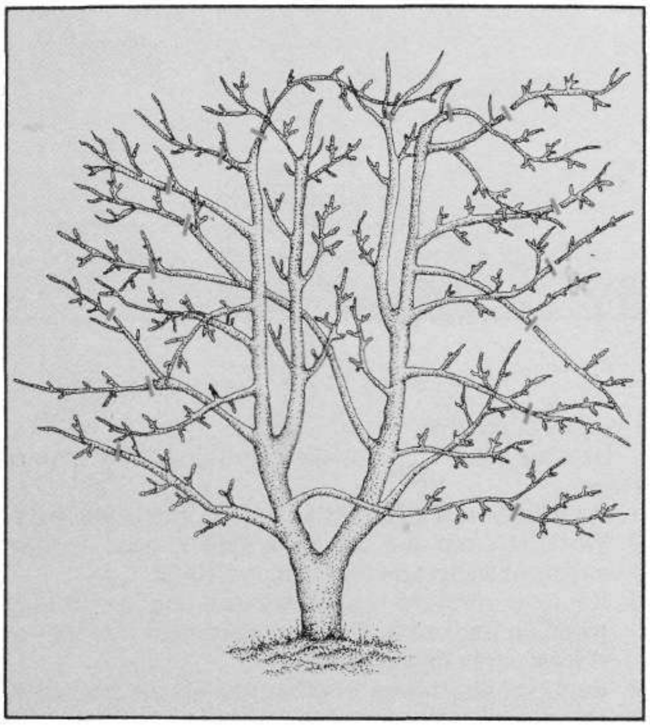
Here are some steps to take in pruning large, mature trees:

1. Prune shoots and limbs that extend into ladder bays.
2. Working from the top of a ladder, head vertical shoots of leaders on each major scaffold.
3. Remove outward and downward-angling fruiting wood on limb ends. Cut to replacement leaders—or at least cut in that direction.
4. Remove old fruiting wood, especially on the underside of limbs.
5. Selectively remove shoots, leaving well-spaced branches to renew fruiting wood.
6. Create space between limbs for passage of sunlight.

Common Fruit Bearers



When reducing the height of a tall tree, look for upright side limbs lower on the leaders. To continue growth in that direction, make pruning cuts just above side limbs. This reduces water sprouts and speeds stub healing.



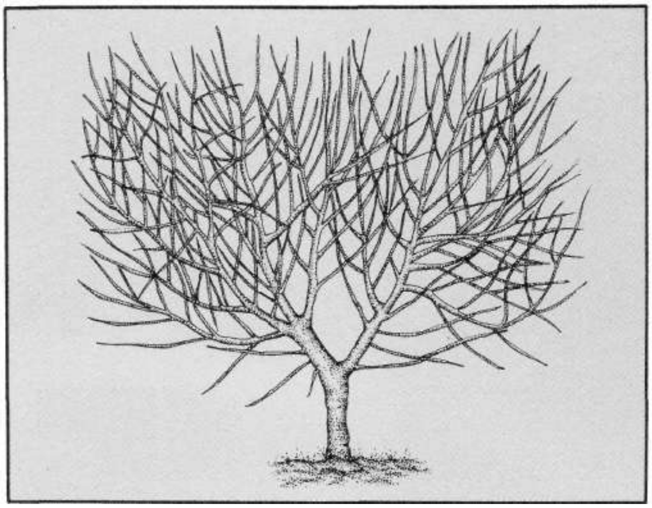
When pruning mature pears, clear ladder bays and re-establish renewal points. Thin shoots but leave enough to renew fruiting wood. Head long shoots and remove old spur systems. Remove water sprouts. See page 94.

This section provides specific information on pruning requirements of common fruit-bearing trees and vines and several nut-bearing trees. Trees and vines are arranged in alphabetical order by common name. The botanical name follows.

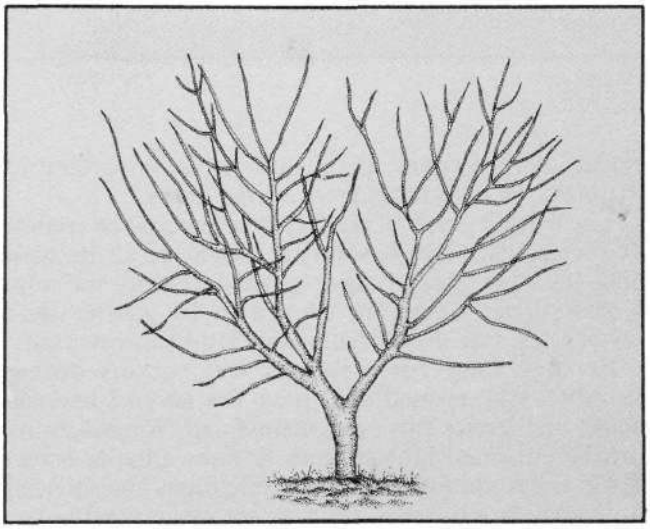
ALMONDS
Prunus dulcis

Almonds bear laterally on spurs that usually live about five years. Train an almond tree with three or four leaders and an open center.

Prune the tree to renew about 1/5 of fruiting wood each year. Cut into wood 1/2 to 1-1/2 inches thick throughout the tree. Remove older, more horizontal wood, especially in upper parts of the canopy. Prune the tree low enough so you are always able to remove some of the highest wood. Prune both upper and lower limbs to ensure adequate renewal of bearing wood.



Before pruning, this almond tree has become too dense for good light penetration and fruit set.



After pruning, the almond tree is well-thinned. The tree will produce nuts throughout the canopy.

APPLES

Malus species

Apple varieties have been classified into four types:

Type I—spur-types, characterized by 'Starkrimson Red Delicious' and 'Jonagold' apple.

Type I trees tend to be upright with narrow crotches and sparse branching. Fruiting occurs on many long-lived short spurs. The fruiting zone is close to the trunk.

Type II—non-spur-types, characterized by most *standard* non-spur strains of 'Delicious'.

Type II apple trees are a variation of type I, with branching more frequent. There is a tendency for the fruiting zone to move away from the trunk.

Type III—spreading-types, characterized by *standard* 'Golden Delicious' and 'Mutsu' varieties.

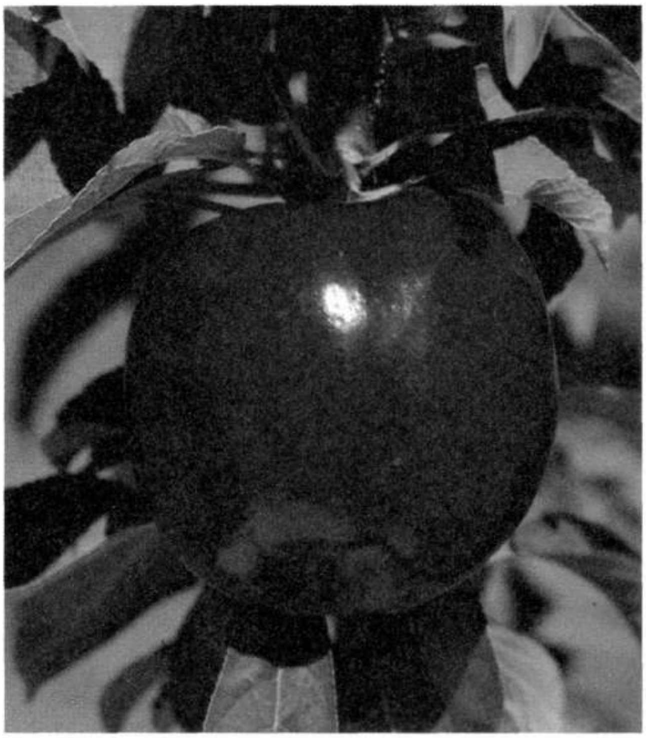
Type **III** apple varieties tend to be wide-spreading with wide crotches and frequent branching. Type III apples bear on spurs and shoots at 1 to 3 years of age. The fruiting zone moves rapidly away from the trunk to the outside of the tree.

Type IV—tip-bearers, characterized by 'Red Rome', 'Granny Smith' and 'Tydeman's Early Worcester'.

Type IV varieties have upright main scaffolds, with narrow crotches and frequent branching. Fruit is borne on the end of last season's shoots. The lower half of shoots may be without leaves or fruit. Fruiting wood moves to ends of branches, causing the tree to spread.

Type I, spur-type, 'Jonagold' apple.

Type II, non-spur-type, 'Red Delicious' apple.



Type III, spreading-type, 'Mutsu' apple.

Type IV, tip-bearer, 'Red Rome' apple.

EARLY TRAINING, ALL APPLE VARIETIES

At planting time, all varieties should be headed at 18 to 24 inches to develop main scaffold limbs. Training can begin in the first summer.

Dwarfs are trained to a central leader. Use a stake or wire to support espaliers.

Semidwarfs are also trained to a central leader. Use a temporary support only if the tree is exposed to strong wind. Spread side limbs if necessary.

Non-dwarf training involves developing three or four leaders at 20° to 30° from vertical. Head leaders annually and remove competing shoots. Spread secondary scaffolds if necessary.

Training and Pruning, Individual Types—Each type of apple tree requires different methods of training and pruning to develop a strong structure and good fruiting habits.

Type I Varieties naturally grow few branches. These varieties tend to be sparse and leggy. Head primary scaffolds to stimulate branching or retain a large number of primary scaffold limbs from the central leader without heading. Dormant-season heading must be followed by thinning branch ends to single shoots after new growth begins.

Once trained, type I varieties require little pruning. Spurs remain productive 10 or more years. However, this is true only if trees have adequate light and don't have a disease that kills most of the old spurs. This disease is known as *dead-spur disease.* If dead spurs occur, renew trees by sawing off entire limbs. Regrow limbs from a nearby water sprout.

Type II Varieties should be trained with few limbs. Use spreaders on scaffold limbs to develop wide crotch angles.

Mature type II trees require moderate to heavy pruning to renew fruit buds. To renew fruiting wood, thin to relatively upright replacement shoots. Nearly horizontal branches may be headed to 2-year-old wood to prevent breakage under heavy fruit loads.

Type III Varieties should be trained with no more than three primary scaffold limbs. After the first fruit crop, head secondary scaffold limbs to stiffen.

Mature type III trees require extensive thinning each year. Thin to upright shoots that appear on 2- or 3-year-old wood. Thinning renews fruiting wood. Lighten branch ends every year by thinning to single, upright shoots.

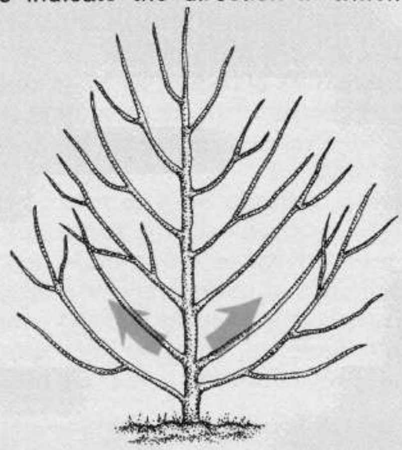
Type IV Varieties should be trained to no more than three leaders. Head leaders annually, about 2 feet from the previous heading. Heading causes branching and stiffens leaders. Midsummer heading also helps in training.

Mature type IV trees require heavy thinning to replace fruiting wood. Make thinning cuts to upright shoots in 2- or 3-year-old wood around the outside of the tree canopy.

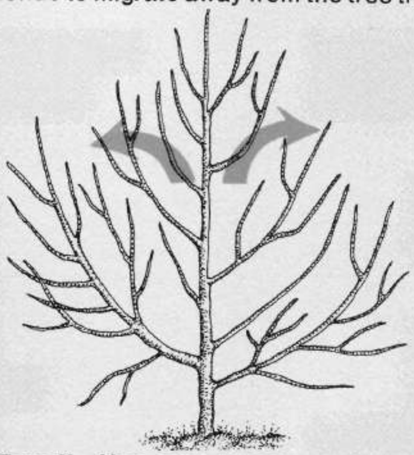
This mature apple tree has been carefully trained and pruned to control size and produce a balanced crop of fruit. The tree is low and easy to harvest.

FRUITING HABITS OF APPLE TYPES

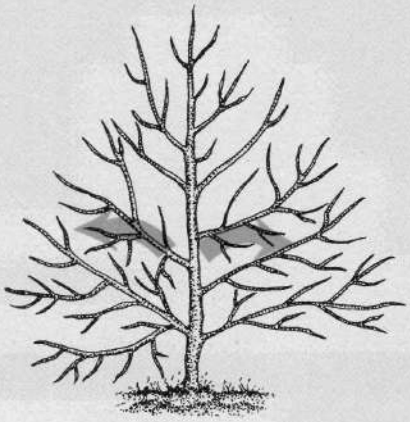
Arrows indicate the direction in which fruiting wood tends to migrate away from the tree trunk.



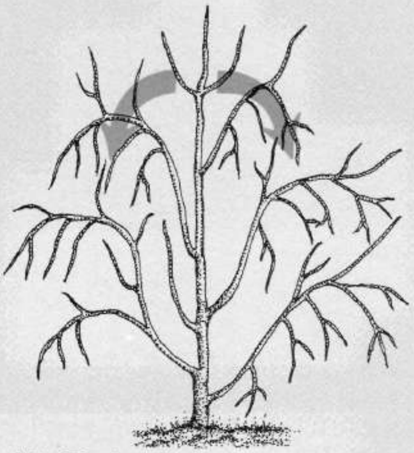
Type I—Spur-types
Characterized by 'Starkrimson Red Delicious'.



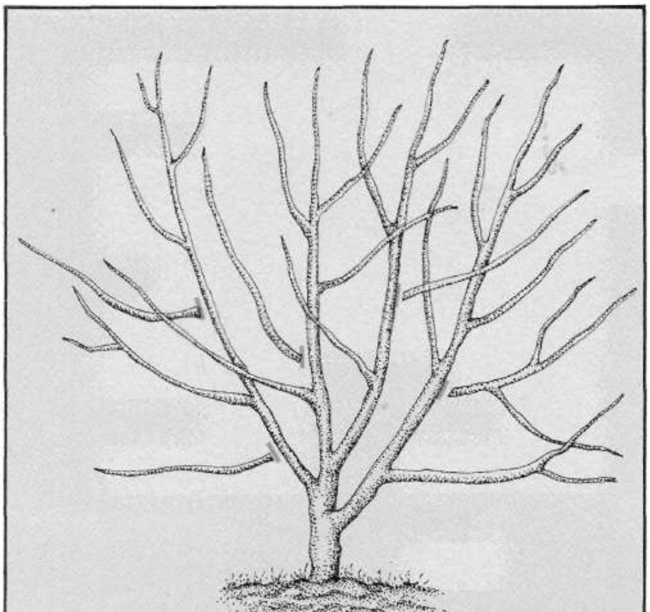
Type II—Non-spur-types
Characterized by standard 'Delicious'.



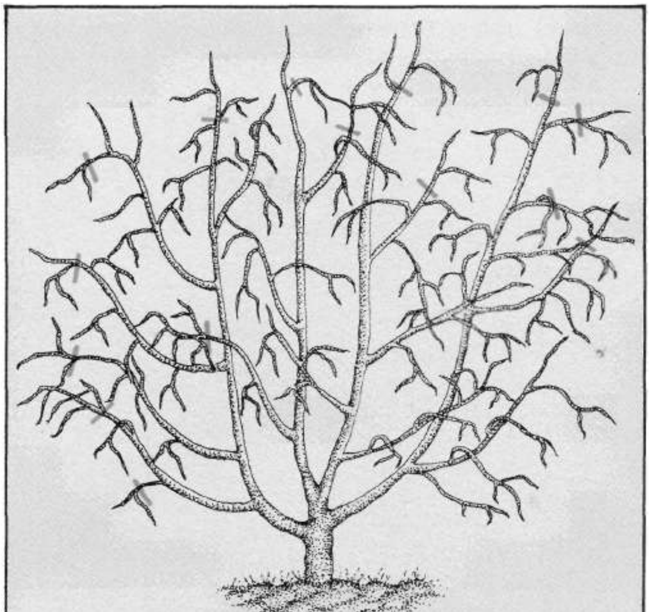
Type III—Spreading-types
Characterized by standard 'Golden Delicious'.



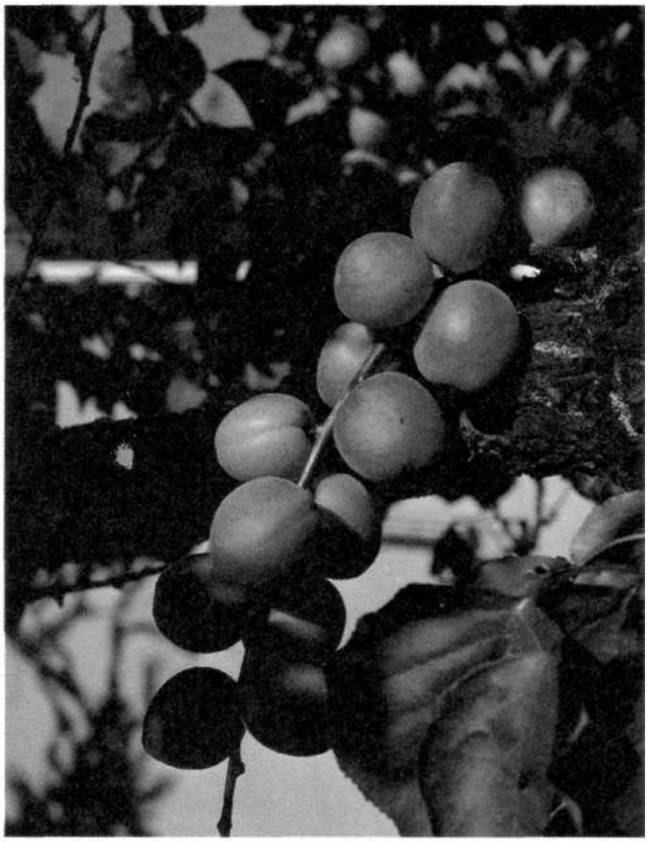
Type IV—Tip-bearers
Characterized by 'Red Rome'.



Fruiting wood can be renewed in type I apple varieties by an occasional large cut. New branch forms at cut.



Type IV apple varieties, or tip-bearers, require many small cuts throughout the tree to renew fruiting wood.



Healthy apricot fruit.

APRICOTS
Prunus armeniaca
Train to vase shape with three leaders. Apricot trees tend to spread excessively, so thin to upright wood.

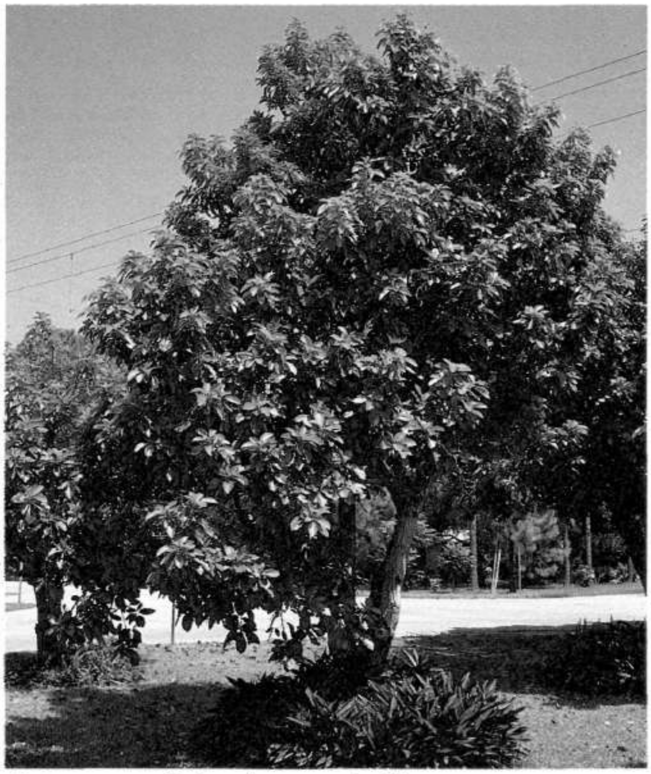
Apricots bear laterally on spurs that usually live for no more than three years. Annually thin bearing trees to upright shoots. Thinning renews fruiting wood and improves light distribution. Don't head remaining branches unless branches are excessively long. Head long branches lightly to contain them.

Mature apricot tree.

AVOCADOS
Persea americana
Train to a multiple leader with three or four main scaffold limbs. Some species have a sprawling growth habit. Control this sprawling habit by selecting upright shoots for framework branches. Remove long horizontal limbs that interfere with development of a sturdy framework. Most varieties produce a strong framework with little training.

Prune mature avocado trees to restrict height and spread and for convenience in harvesting. Pruning maintains productivity of lower limbs by admitting light. Lighten ends of excessively spreading branches to prevent breakage caused by a heavy crop load. In tall, slender varieties, remove or shorten long branches in the top of the tree to prevent breakage.

Mature avocado fruit, ready for harvest.



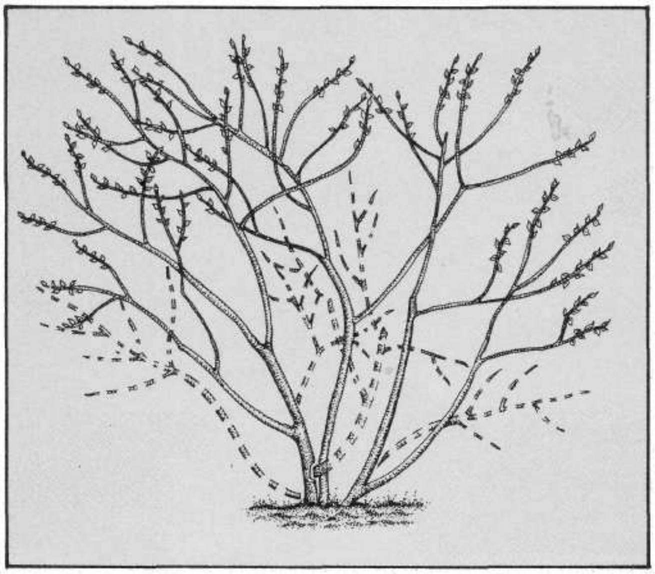
Mature avocado tree has rounded form.

Blueberries require little pruning. Fruit is sweet, juicy and delicious.

BLUEBERRIES

Vaccinium species

High-bush blueberries are slow-growing, long-lived woody shrubs that require little pruning. Head rooted cuttings at planting with no additional training. Prune bearing plants close to the ground in winter or early spring. If shoots are too crowded, remove some older shoots entirely. To increase fruit size, head shoots that have an abundance of flower buds.



Prune blueberries by removing oldest, weakest shoots in winter or early spring. Remove weak side shoots in top of plant. Increase fruit size by heading back shoots that have an abundance of flower buds.

CANE FRUITS

Rubus species

The genus *Rubus* includes blackberries, boysenberries, loganberries, red raspberries and others. With few exceptions, these plants share common growth and fruiting habits. Canes grow one season and produce blossoms and fruit the next season. A few everbearing raspberries produce fruit in late summer on canes produced the current season. Wild, untrained and unpruned blackberries are difficult to pick because of thorny canes.

Train and prune these fruits with these objectives:

Support fruiting canes for ease of harvest. When fruiting canes are supported, new canes spread out below fruiting portions.

Separate fruiting from non-fruiting canes for ease of harvest. This makes removal of fruit easy and protects non-fruiting *primocanes* from pickers and cultivation. Primocanes are canes that appear during the first season of growth and before flowers appear.

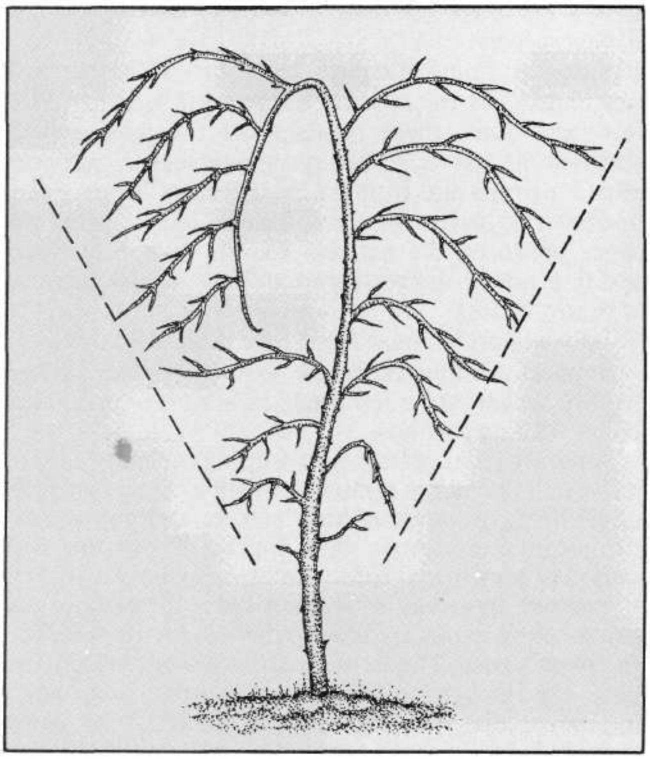
Prevent spreading of fruiting canes throughout the garden. New canes are headed to force fruiting close to the plant's base. The farther berries are borne from the base, the smaller the fruit are at maturity. Keep canes in the trellis row and protect canes from being trampled by pickers, mangled by cultivation or sunburned.

Blackberries are produced on slender, thorny canes. The canes require support.

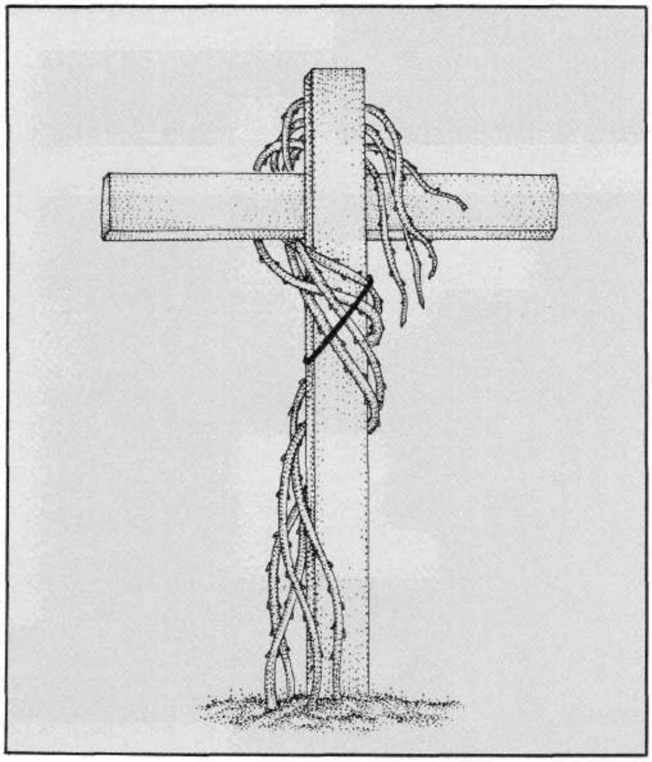
Bliackberries—Immediately after harvest, remove fruited canes and train the strongest new canes loosely on a two-wire trellis. Remove weak canes, keeping 8 to 10 strong canes. A fanlike arrangement of canes is best because it allows for the best fruit and leaf development. Group several canes together in bundles for easy handling.

In addition to new canes that rise from the crown, erect blackberries send up root suckers. Pull out all root suckers. Head canes at about 6 to 8 feet in hot climates; 8 to 10 feet in cool climates.

In winter, after leaves fall, remove all laterals within 2 feet of the ground. Head any long laterals from 12 to 15 inches. Head shorter laterals less to increase fruit size.



To prune blackberries, remove all laterals within 2 feet of the ground in winter, after leaf fall. Head long laterals to 12 to 15 inches long. Head shorter laterals less to increase fruit size.



Where space is limited for growth of blackberries, canes can be tied to a post with a crossbar. Don't tie canes too tightly, or they can be damaged as they grow.

Red Raspberries—After planting, prune the top to a 1- or 2-inch stub. If no pruning is done at planting time, the plant may set a few fruit. But the plant may fail to produce new growth in following years. Although a crop may be harvested the second year, it takes three years before full bearing is reached.

Raspberries may be trained to a *hill*, a *linear-row* or a *hedgerow* system.

The hill requires the least space because all suckers are pruned off with a shovel. Removing suckers prevents the plant from spreading beyond the hill. Six to 10 bearing canes are kept each year to form the plant. Hills are spaced about 5 feet apart. New canes are produced from large leader buds at the base of the old canes.

In the linear-row system, only leader buds are used

Raspberries should be grown on supports of posts and wire.

to produce canes. Plants are set 2 or 3 feet apart.

In the hedgerow system, plants are set 3 feet apart. Both leader buds and suckers in the row are allowed to develop.

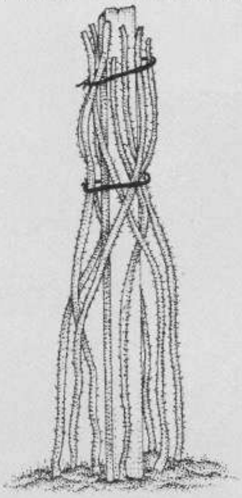
All three systems require support from stakes, or posts and wire. Supports are important where canes grow to heights greater than 4 or 5 feet. If canes grow less than 4 feet, canes will stand without support after light heading. Supports help keep berries clean, make picking easy and help separate fruiting canes from primocanes. Remove fruiting canes immediately after harvest.

Red raspberries are often supported by two parallel, horizontal wires about 18 inches apart. The wires are held by crossbars. Headed canes are pulled up between wires as fruiting canes are removed.

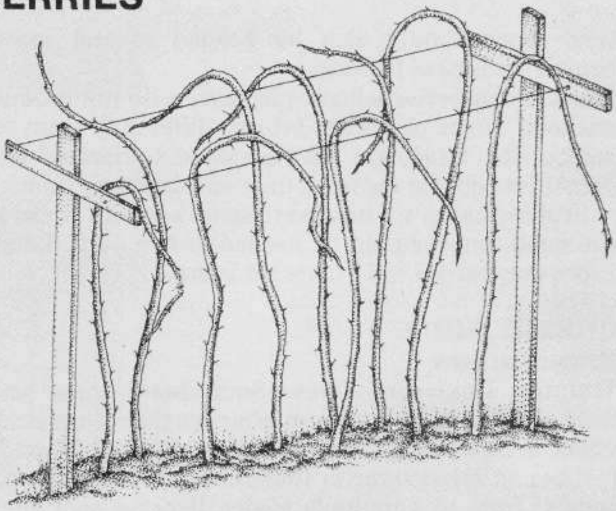
Canes of ever-bearing varieties fruit on the tips the first year. More fruit is produced on the basal portions in following years. Annual pruning consists of removal of second-year canes after canes have fruited. First-

Beautiful fruit of red raspberries are delicious. Pruning helps canes produce bigger, better fruit.

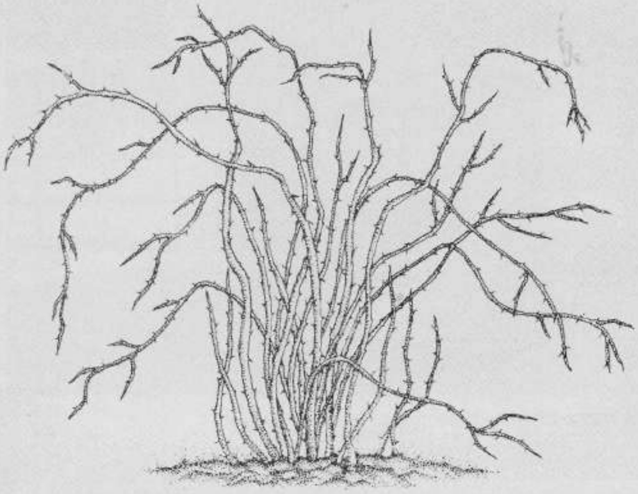
TRAINING AND PRUNING RED RASPBERRIES



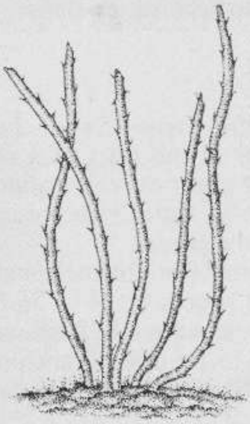
Single red raspberry plants can be trained by tying canes to a stake.



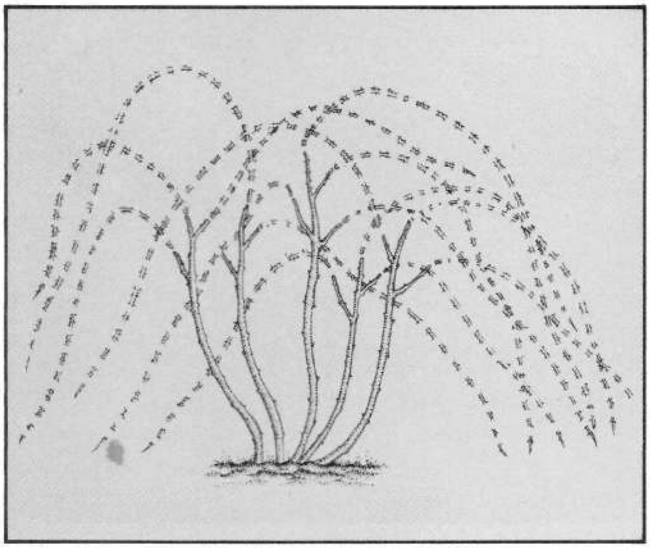
Red raspberries can be supported by two parallel, horizontal wires. Wires are spaced 18 inches apart and held by crossbars. Pull headed canes between wires.



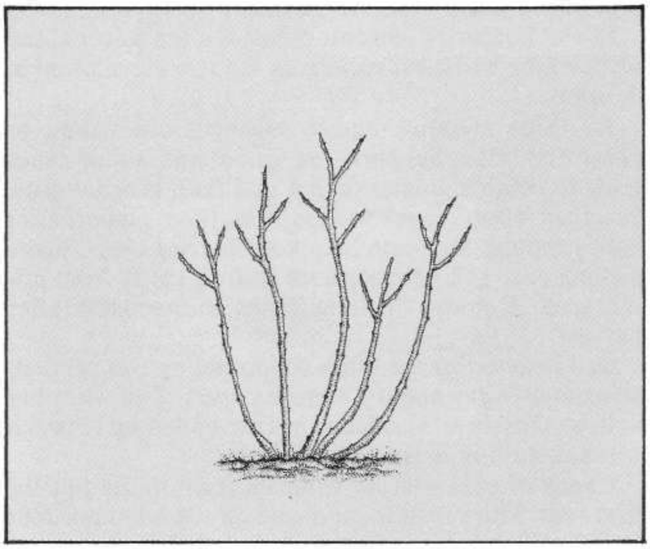
Red raspberries can be left free-standing. If plants are allowed to grow too long, fruit rubs against ground.



To prevent loss of fruit from free-standing raspberry bushes, head all canes over 4-1/2 feet long.



Before pruning, black raspberries have long canes. Fruit rests on ground and can be ruined.



After pruning, raspberry canes are free-standing. Plants will produce more and better fruit.

year canes should also be headed several inches behind the area of fruiting.

Black Raspberries—Black raspberries do not produce suckers. These plants are pruned differently from red raspberries. Canes are left free-standing because they are stiffer and less vigorous than red-raspberry canes.

Fruiting canes are headed to spurs annually. Laterals on small canes should be headed to two buds. Larger canes may carry 8 to 12 buds per lateral.

CHERRY, SOUR
Prunus cerasus

Training Immature Trees—Sour-cherry trees have weak wood and tend to form crotches that break easily under a load of fruit. Head nursery trees at 18 to 24 inches and select three or four shoots with wide crotch angles. Train to a multiple leader. Because sour cherries branch freely, heading is not required after the first dormant heading of scaffold limbs.

Pruning Bearing Trees—Contain height and spread by thinning as needed. Sour cherries also tolerate hedging if not allowed to become too dense.

CHERRY, SWEET
Prunus avium

Training Immature Trees—Sweet-cherry trees ordinarily branch only at the start of a season's growth. Sometimes, sweet cherries won't branch at all. If not pruned, these trees quickly become tall with few branches close to the ground.

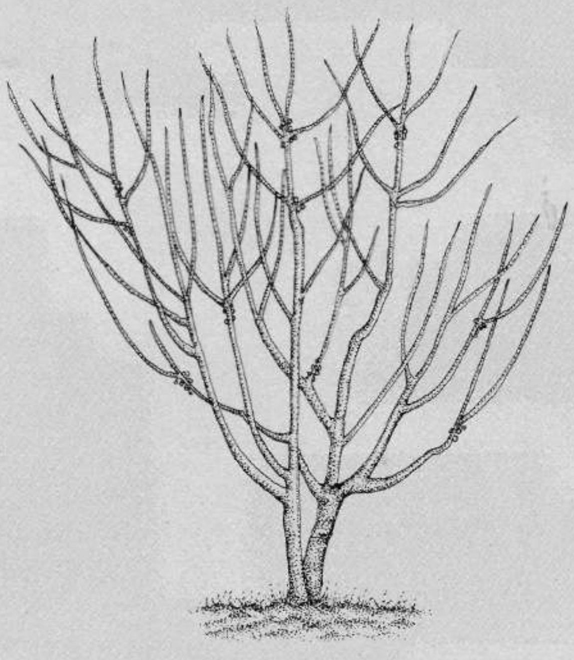
Head trees about 18 to 24 inches above ground at planting. Head all shoots to 24 to 36 inches after the first and second year's growth. Remove terminal buds of shorter shoots to promote branching. In the third and fourth years, head only the vigorous shoots. When fruiting begins, gradually remove a few scaffolds until seven or eight remain. Head all shoots annually in dormant season. Heading develops low, spreading trees that are easy to pick.

Pruning Mature Trees—Sweet cherries fruit on spurs that live up to 10 years. Thin tops as necessary to let in more light and keep upper limbs in reach. Prune old, devitalized trees harder, using both heading and thinning cuts to increase vigor.

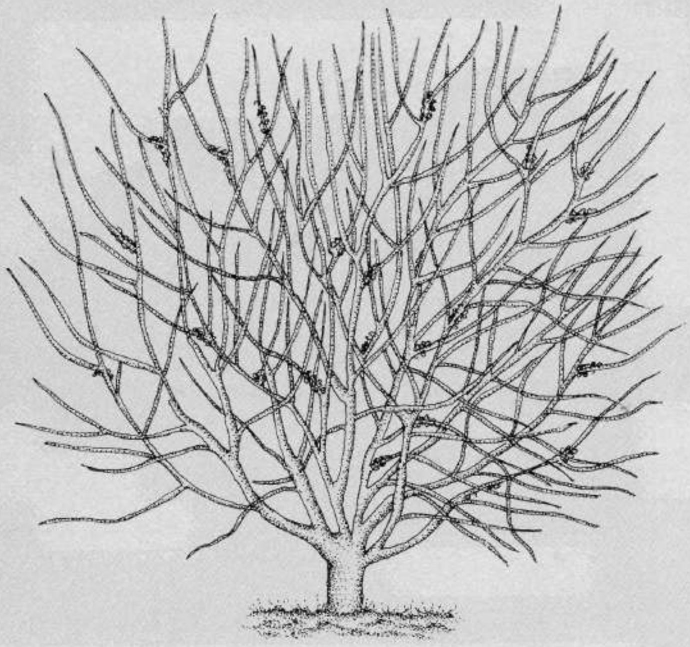
Mature cherry tree.

Fruit from a healthy sweet-cherry tree is round and juicy, bright-red in color.

TRAINING A CHERRY TREE



Without proper training, this sweet-cherry tree is too tall and sparsely branched. The tree will produce small fruit of poor quality.



Heading all shoots of a young sweet-cherry tree will produce more branches and a lower tree. It will be easy to spray and harvest.

Burred hulls and toothed leaves of chestnut.

CHESTNUT

Castenea mollisima

The edible chestnut needs little encouragement to grow with a single straight trunk. Develop wide-spreading permanent scaffolds about 6 feet above ground. Mature trees seldom need pruning.

CITRUS

Citrus species

Oranges, grapefruit and lemons are closely related members of the citrus family. These plants have similar growth and fruiting habits.

Citrus are evergreens and do not have reserves of starch for growth. Citrus grow, bloom and fruit at any time when weather is favorable. This makes pruning for renewal of fruit unnecessary. Citrus are pruned to let light and chemical sprays into the center of the tree, for containment and for appearance.

Prune tops regularly to keep trees from becoming too tall. Avoid pruning lower, outer limbs. These limbs produce most of the fruit. Train by thinning to maintain a compact shape. Thinning ensures that early fruiting takes place on wood strong enough to support weight of fruit. Thin to strong laterals or to main branches at any time in frost-free areas or after danger of frost in cold climates.

Oranges—Training is necessary to prevent breakage under weight of heavy crops and to keep lower limbs high. Train trees to a central leader. Gradually remove lower side limbs and raise the head. Train until trees are high so lower limbs can spread out and downward without touching the ground.

Once established, oranges need little pruning except to remove dead, twiggy growth.

Grapefruit—Prune the same way as oranges.

Lemons—Because lemon trees grow more open and rangy than other citrus, more pruning is needed to

Mature evergreen lemon trees produce tangy, colorful fruit.

keep lemon trees under control. Lemons respond to pruning with vigorous new growth.

Head young trees at about 3 feet and select three or four main leaders. Head leaders severely to balance the top if many roots have been removed through transplanting. More leaders may be selected as trees grow. Thin and head as required to develop compact trees.

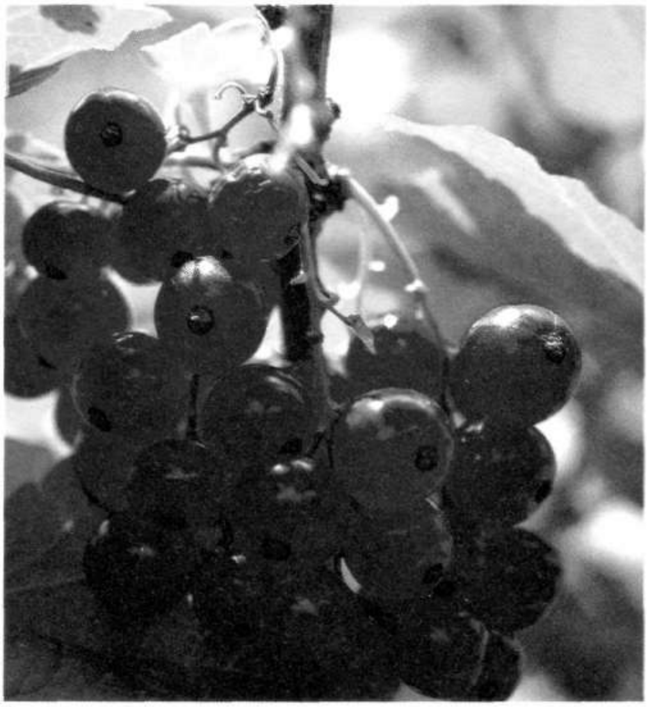
Lemon trees produce strong-growing water sprouts on the trunk. Water sprouts run up through the center of trees and cause crowded conditions. Properly spread, water sprouts can be used to fill gaps in the canopy. Pull water sprouts over before they are too stiff or tie them in place. Remove all unwanted water sprouts several times annually. Prune rangy branches to solid wood closer to the trunk. This lightens branch ends and prevents breakage.

Orange tree with fruit, ready for harvest.

Rejuvenating Citrus Trees—As citrus trees get older and larger, they produce fewer and smaller fruit. This happens because inside and lower limbs become weaker from shading. Topping and hedging are used to correct this problem. Pruning can be done all at once, with a consequent loss of yield. Or pruning can be done gradually, removing parts of the tops and sides each year. Removing deadwood allows more light into the interior and stimulates new growth. In areas with a frost hazard, don't prune until after the frost-free date.

Old, weak trees can be renewed by *skeletonization*. Skeletonization removes all foliage and all wood less than 1 inch in diameter. It stimulates the production of much new wood. A coating of whitewash must be applied to the entire tree immediately after skeletonization to prevent sunburn of the limbs.

If wood in lower limbs becomes weak and sickly, remove branches by undercutting. Leave new upper foliage.



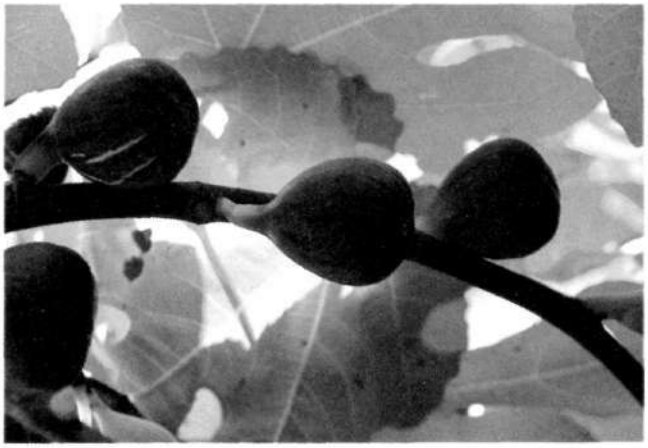
Red currants.

CURRANTS
Ribes species
At planting, cut tops back to two or three canes. Head these canes to stimulate shoot development. On bearing bushes, remove any borer-infested wood and destroy it immediately. Remove weak shoots and head other shoots a few inches.

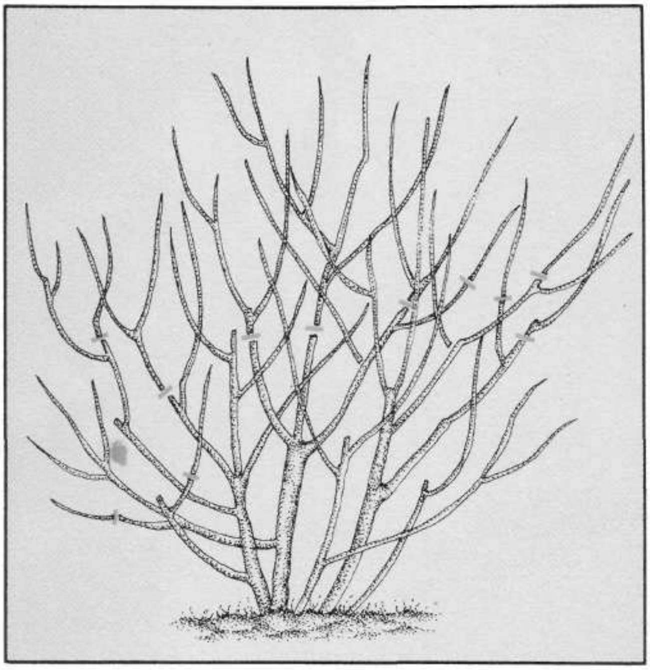
On a mature bush, thin to keep two to four third-year canes, three to five second-year canes and four to six first-year canes.

With black currants, remove all canes over 1 year old and thin the rest. Head 6 to 10 of the strongest canes, removing approximately 1/4 of the growth.

FIG
Ficus carica
Training Young Trees—Figs can be grown as bushes with multiple trunks or as trees. In cold regions, fig bushes regenerate faster after a freeze than single-trunk trees.



Mature 'Mission' figs.



Pruning bush-form figs is easy. Thin to control height. Head to stimulate new fruiting branches.

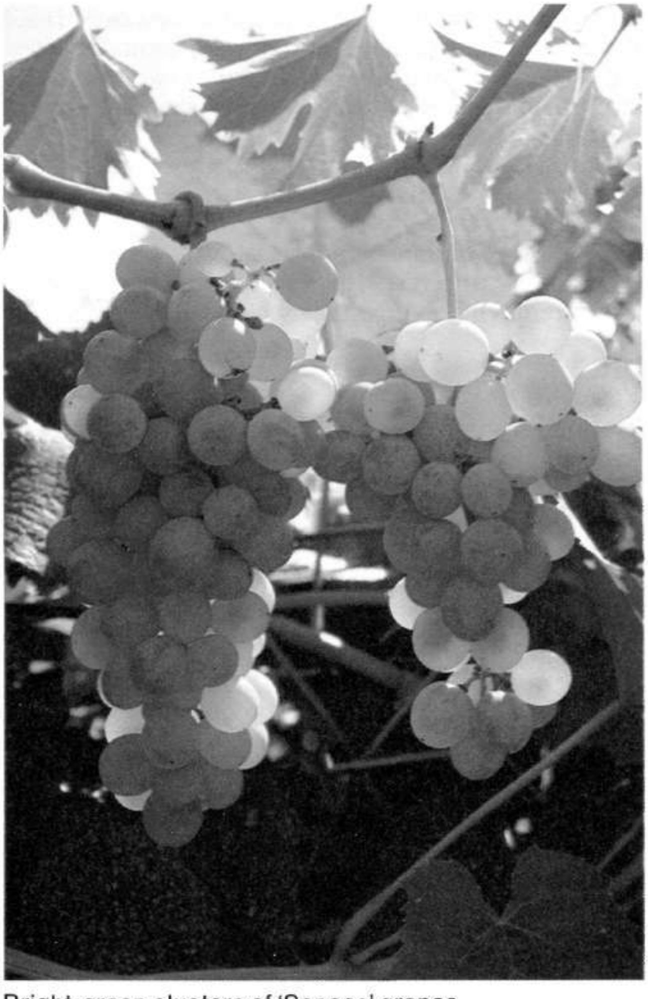
To train as bushes, plant in a depression and head 12 inches above the ground. After several branches have formed, fill in the depression and mound soil so the bases of the shoots are below ground. Head shoots annually at 2- or 3-foot intervals to stimulate branching. This ensures fruiting close to the ground.

Train fig trees to the multiple leader system with three or four main scaffold limbs and two or three secondary scaffolds on each main scaffold. Remove suckers and basal sprouts annually.

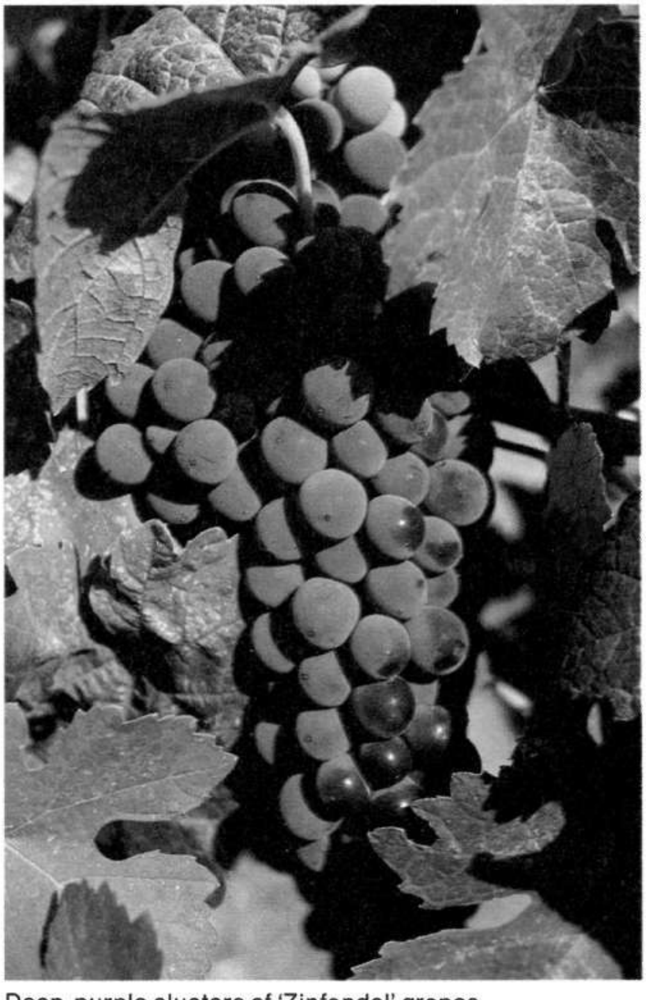
Pruning Mature Trees—The first crop of some fig varieties is borne on previous-season's wood. Because most of this old wood would be removed by heading, prune mature trees by thinning. Remove any suckers.

Some fig varieties produce primarily on current-season's shoots. Head all of the previous-season's shoots to one or two buds during the dormant season. Remaining buds produce long shoots that bear 10 to 15 figs.

GOOSEBERRY
Ribes species
Cut back to several strong shoots at planting time. Train to a spreading bush. Thin shoots to allow space for picking berries without being stuck by thorns. On bearing bushes, remove branches over 3 years old.



Bright-green clusters of 'Seneca' grapes.



Deep-purple clusters of 'Zinfandel' grapes.

Grapes grown on arbors provide shade and fruit for enjoyment by all.

New grape leaves in spring.

GRAPE
Vitis species

Three species of grapes are grown in the United States: *Vitis vinifera,* the European grape; *Vitis labrusca,* a native of northeastern America; and *Vitis rotundifolia,* known as *muscadines* and grown in the southern parts of the United States. Some hybrid varieties are also grown. The principal *Vitis labrusca,* or *slipskin,* variety is Concord. This grape is used in making grape juice, grape jelly and for fresh table fruit.

Many table grapes such as Thompson's Seedless and Tokay, as well as most wine grapes, are varieties of the European or *Vitis vinifera* group.

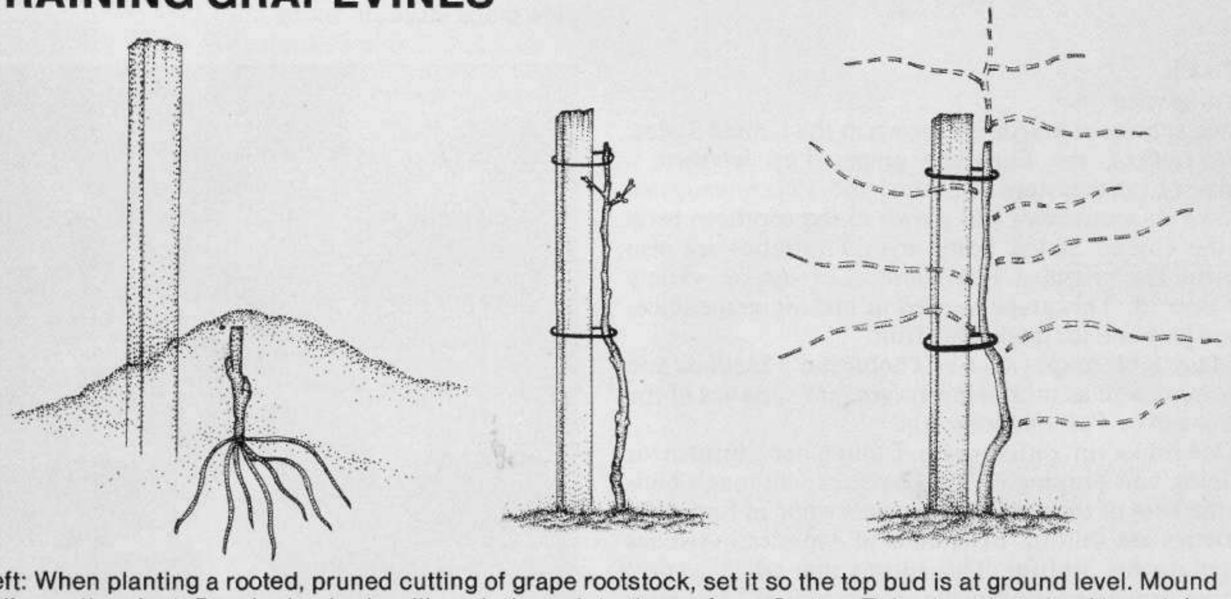
One important difference in fruiting habit influences training and pruning of these species. Although buds on the base of the previous-season's wood of European varieties are fruitful, basal buds of American varieties often are not fruitful. This means that while *vinifera* can be pruned back annually to two to four basal buds on each cane, *labrusca* and *rotundifolia* varieties must keep much longer stretches of cane.

Grapevines are trained and pruned for two reasons. One is to train vines for the gardener's needs. The second is to increase fruit production. Grapevines can serve other purposes too. On a multilevel trellis, grapevines can shade and cool the sunny side of a house in summer. In winter, when leaves are off, grapevines admit light and warmth. Grapes can be used to screen areas from view, increasing privacy. Grapevines on an arbor can shade a patio or a bed of begonias. Be careful where you plant grapevines. Vines may need to be sprayed for disease and insect control and sprays can drift onto surrounding areas.

Swollen grape bud in early spring.

Grapevines after about 1 month of growth.

TRAINING GRAPEVINES

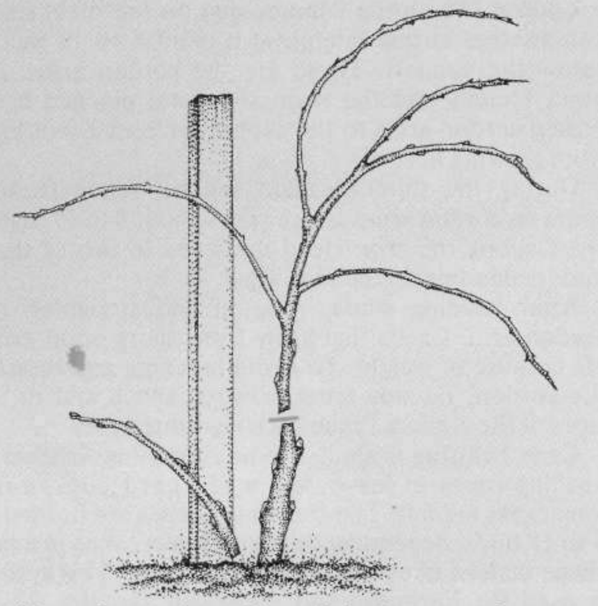


Left: When planting a rooted, pruned cutting of grape rootstock, set it so the top bud is at ground level. Mound soil over the plant. Developing buds will push through to the surface. Center: This shoot is trained to a stake. Tie shoot loosely to the stake and allow laterals to develop. Remove suckers from roots or crown. Right: At the first dormant pruning of the grapevine, remove all but one strong cane. This single cane is pruned back to two or three buds.

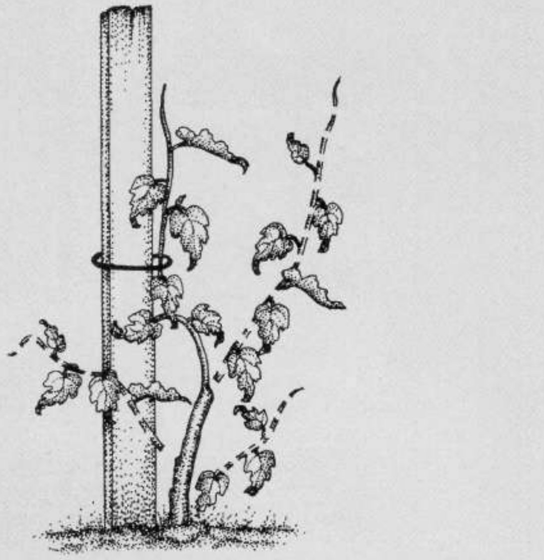
Training New Plantings—Grapevines are usually obtained as rooted cuttings and trained to a stake. Head cuttings to three buds and prune roots to about 6 inches. Plant top buds level with the soil surface. Mound loose soil over the top of plants to protect from sunburn, especially in hot climates. At this time, insert a stake next to plants. As canes grow, the stake supports them. The growing shoots push out of the ground.

At the first dormant pruning, remove all but one cane from vines. Cut single canes back to two or three buds. After a few inches of growth have been made in the second summer, the best-placed and strongest shoots are saved and others are removed. Shoots are tied loosely to the stake that was set at planting time. Remove suckers from roots and old stems. Allow tied canes to branch freely. Vines to be head-trained, cordon-trained or cane-pruned are trained to stakes.

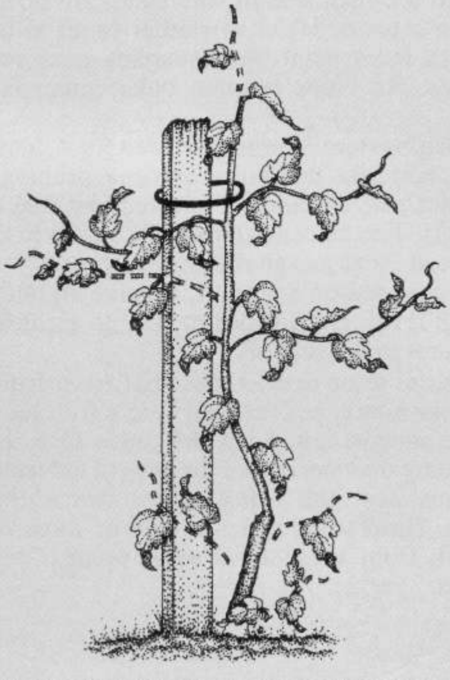
HEAD-TRAINING GRAPEVINES



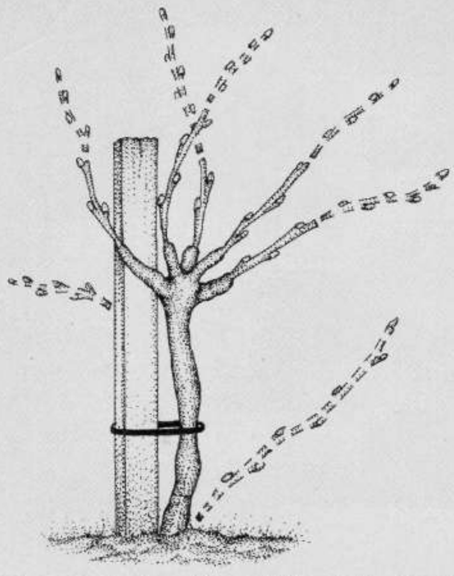
After a few inches of growth in the second summer, the best-positioned and strongest shoot is saved. Other shoots are removed.



Canes of head-trained vines are cut off at the node or dormant bud. Cut through nodes to destroy buds above where the head is to be formed.



Mature, head-trained vines of European grapes are usually spur-pruned. Prune vines severely to control sprawling growth.



All lateral canes below the middle of the trunk are removed entirely. Weak laterals in the upper half of the vine are also removed.

Head Pruning is used for training European grapes when plants are confined to a small space.

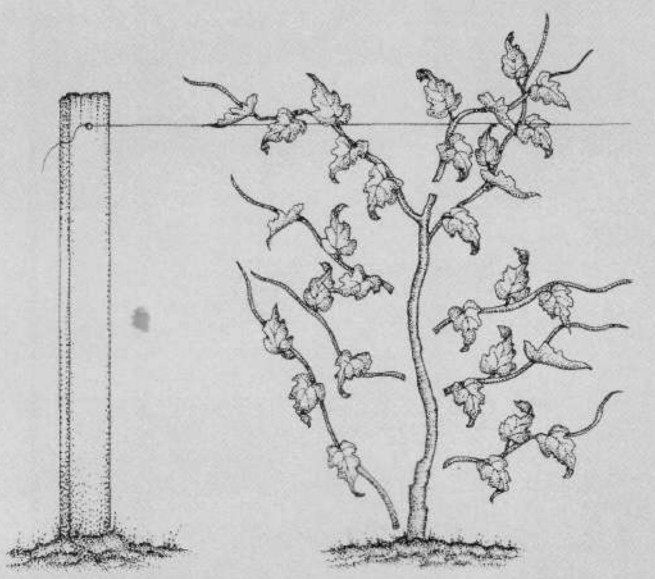
Canes of head-trained vines are cut off at the node *above* where the head forms. Cut through the node to destroy the bud. Tie canes tightly to the top of supporting stakes and loosely about halfway to the ground.

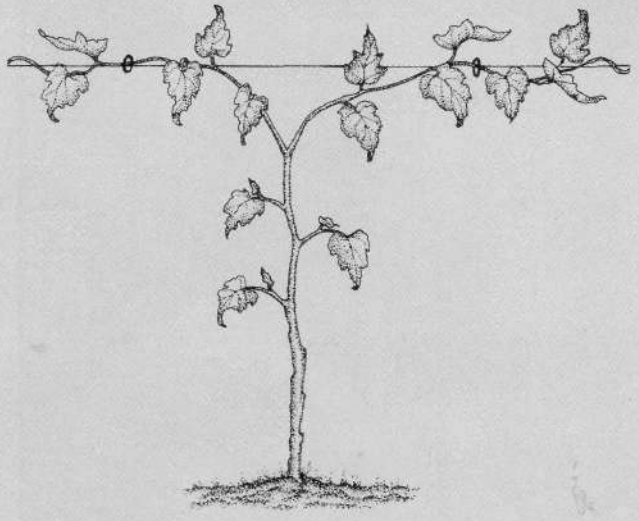
Remove all lateral canes below the middle of the trunk. Weak laterals in the upper half should be removed. Two to four of the stronger laterals may be headed to two or three basal buds. The greater the diameter of vines, the more buds that can be left.

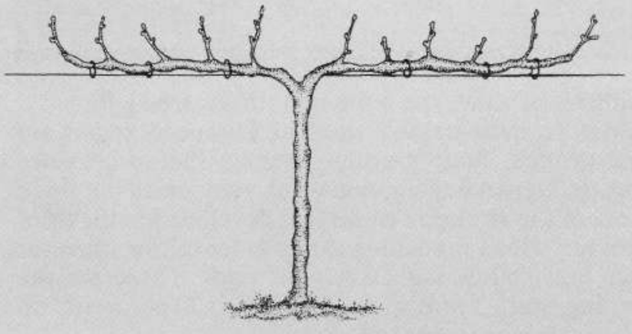
Mature head-trained vines of European grapes are spur-pruned. Spur pruning restricts the space vines occupy. Depending on vine vigor, remove all but three to six of the strongest canes that developed in the third summer. Head remaining canes to leave two, three or four basal buds, based on vine vigor. These are the fruiting spurs. More spurs, from 10 to 20 per head, are left each year as vines age.

Cordon Design is a modification of head training.

CORDON-TRAINING GRAPEVINES







Top: A cordon is a permanent, horizontal branch on a wall or trellis. In the second summer, cordon-trained vines are allowed to go unheaded. Two strong laterals are chosen. Pinch back all other laterals and the main shoot.

Center: Two laterals are trained in opposite directions along the trellis. Space ties a foot away from the growing points.

Left: During the third dormant season, fruiting spurs are spaced 8 to 12 inches apart along laterals. Spurs are cut to two or three buds, depending on cane vigor.

Cordons have two permanent laterals that stretch in opposite directions along a support. This support may be a wire trellis, a wall or the top of a fence.

Choose two strong laterals, one on the main shoot and another strong lateral, at a point 8 to 10 inches below the support. These are the cordon arms. All other laterals and the main shoot are pinched back. Fasten cordon arms to the support at least a foot back from growing tips.

During the third dormant season, retain fruiting spurs on cordon arms. Space spurs about 8 to 12 inches apart, along the arm. Head the spurs to two or three buds depending on the cane vigor.

After heading spurs, refasten and straighten the cordon arm. Canes that grow from spurs often break off because of weight. To avoid breaking and twisting the cordon, tie side arms to wires above and to the sides of the cordon. Pinch back vigorous canes.

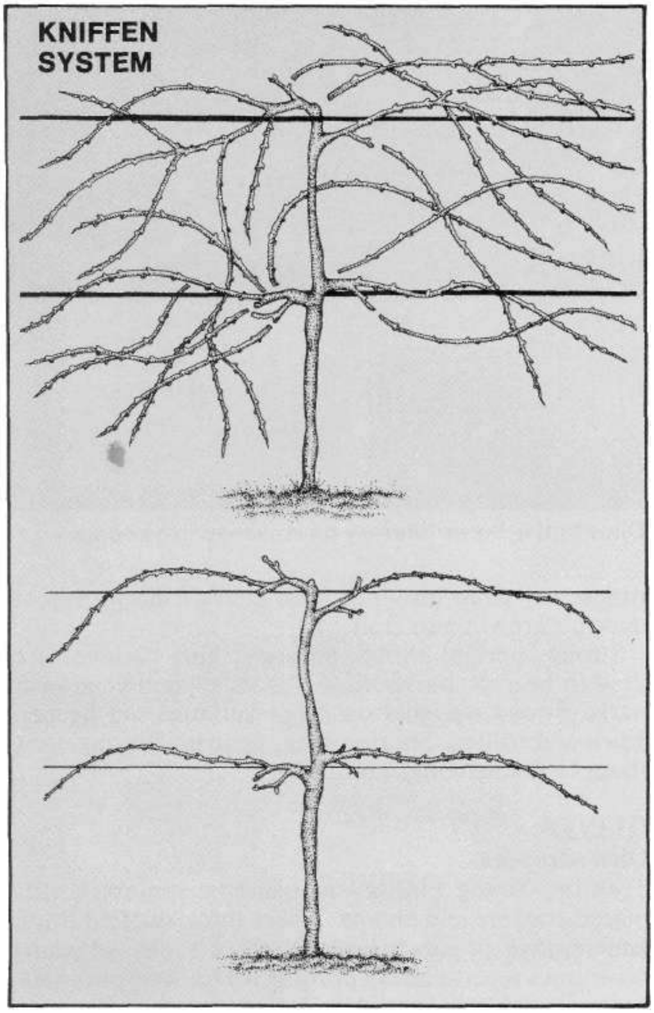
Cane Pruning is similar to head pruning. Instead of heading canes to leave only a few basal buds, a few long canes are left. The remaining canes are headed to 6 to 18 buds, depending on vigor. Select canes in a fan-shape instead of evenly around the trunk. This system is used for European and American varieties. Many European varieties are more productive if pruned by the cane system.

In the third dormant season, two canes are selected and tied to a support. Head two other canes at basal buds. Growth from basal buds supplies next year's fruiting canes. As vines become older, more canes may be kept.

The Kniffen System, commonly used for American varieties, is basically the same as cane pruning. A second, higher pair of canes is selected and tied to a higher support. Tie the central leader to a cane to keep it straight. Head canes just above top vines.

After the next season's growth, remove all but two canes at each level. Head canes to four to eight buds and fasten canes to the support.

In later years, remove all canes that have fruited. Select vigorous new canes for next year's fruiting. Tie canes to the support and head the canes to 6 to 10 buds, depending on vigor. From the base of old fruiting canes or arms near the trunk, select two or three strong canes. Head these canes to two or three buds each. Growth from these buds supplies next year's fruiting canes.



Top: American grapes are trained by the Kniffen system. This system is similar to cane pruning, but with an additional upper wire. Tie the central cane to a stake and head cane just above top wire. After next season's growth, prune away all but two canes at each wire level. Cut canes to two to four buds and tie to trellis.

Bottom: In later years of Kniffen pruning, remove old fruiting canes and select vigorous canes for next year's fruiting. Tie canes to trellis and cut back to 6 to 10 buds. Select two or three strong canes from base of old fruiting cane or arms near the trunk. Cut canes back to two or three buds each. Growth from these buds will supply next year's fruiting canes.

Training To An Arbor is similar to the Kniffen system. The leader is not headed until it has grown across the entire trellis. Once the basic framework of vines is established, side arms can be cane-pruned or spur-pruned.

HAZELNUTS

Corylus species

Training Young Plants—It is easier to train hazelnuts as bushes than as trees. At harvest time it's more difficult to rake nuts from under bushes than to harvest trees. To train hazelnuts as bushes, plant trees and let them grow without removing suckers. To grow trees, remove all 6- to 12-inch-long suckers close to the trunk. Remove suckers in spring. Remove suckers annually throughout the tree's life. Train trees to a multiple leader with four or five main scaffold limbs.

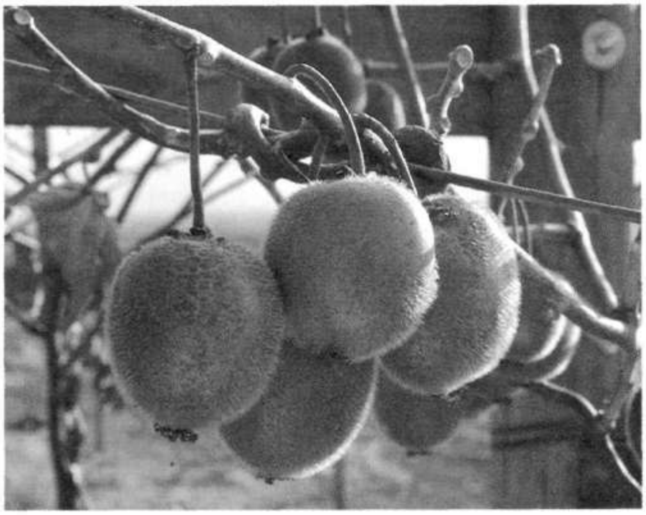
Pruning Mature Trees—Prune mature hazelnut trees severely once every four or five years. Remove all twiggy, horizontal wood of poor vigor. Make thinning and heading cuts into wood 1 to 2 inches in thickness throughout the top. Thinning and heading stimulates vigorous new growth that produces heavily the second season after pruning.

KIWI

Actinidia chinensis

Training Young Plants—The kiwi is a vigorous vine that requires careful training on supports. Vines must be pruned properly to renew fruiting wood. Vines should be grown where they are not exposed to high wind. Construct a trellis 6 feet above ground or train vines to a wall or fence. Permanent arms are trained

Mature hazelnut tree requires heavy pruning to maintain form and control growth.

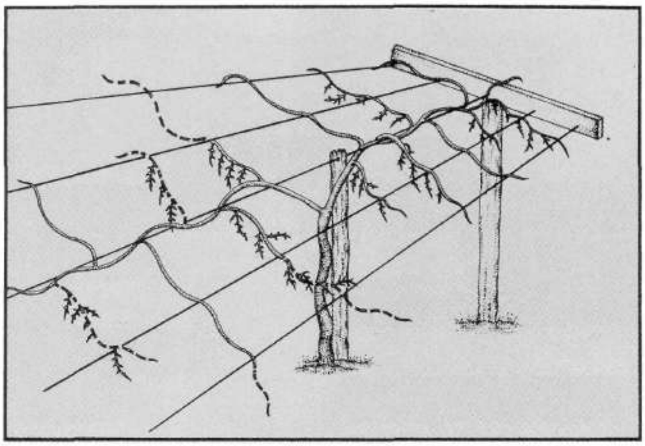


Pick kiwi fruit as color turns from green to brown.

along the trellis. Fruiting occurs on side branches. Kiwi may also be trained on flat-topped *pergolas*. Pergolas are arbors with an open roof of crossed rafters or wires.

Stake kiwi at planting time and train a single leader up the support system. During the growing season, remove all side growth not needed for the main stem. When the leader reaches the permanent supports, train two leaders in each direction. Remove all other shoots. A single leader in each direction is satisfactory, but more fruit is produced when two are used together. As leaders grow, twist them around the wire with a full turn every 18 to 24 inches. Leaders can also be tied into position. A system of temporary fruiting arms develops at 12- to 15-inch intervals along these leaders.

Head Suiting laterals to seven or eight buds early in the season. Shorten excessive growth back to the same point. Laterals are grown for three seasons and fruited for two before they are removed. When kiwi are grown



Kiwi fruit are trained on fruiting laterals. Laterals produce fruit for three years, then should be removed.

on pergolas, head spurs harder and more often to keep them as short as possible.

Prune kiwi in midwinter to avoid bleeding. Remove all 3-year-old fruiting arms each year. Head younger fruiting arms, but leave two buds past where the fruit was borne. Head new canes to clear the ground.

To train kiwi on a pergola, plant vines down the middle and train single stems to the top of the pergola. Let vines branch and train one or two branches to become main leaders. Allow these leaders to grow lengthwise up and down the center of the pergola. Develop a series of permanent, horizontal, fruiting-secondary laterals at right angles to the main leaders. Fruiting-secondary laterals should be 24 to 30 inches apart. Temporary fruiting spurs are developed along permanent secondary laterals.

To ensure adequate pollination, graft in a male *scion* in place of every ninth fruiting arm. Scions are buds of stems of the kiwi plant. Scions develops into *staminate arms or* male pollen-bearing organs.

Pruning Bearing Vines—Summer and winter pruning is needed to control the exceptional vigor of kiwi vines. Fruiting occurs on the first two buds of current-season's growth. Although new canes may appear at

Olive fruit is borne laterally on last season's shoots.

almost any point on vines, only canes from previous-season's growth bear fruit.

Strong, upright shoots on some kiwi varieties are slow to bear. Remove these shoots soon after growth starts. Strong uprights on other varieties can be tied down and fruited. Shorten long, pendant fruiting arms about 18 inches above ground.

OLIVES
Olea europaea

Training Young Plants—At planting, remove poorly placed suckers and shoots. Select three scaffold limbs and remove or pinch back all other limbs. If young olive trees receive heavy pruning for training purposes, they will not bear fruit. Avoid pruning until after trees have begun to bear.

Once trees start to produce, gradually select about nine well-placed secondary scaffold limbs. Thin out surplus limbs. Too-severe thinning during a year forces trees into a non-fruiting, vigorous-growing condition.

Bearing Olive **Trees—**Olives are borne laterally on shoots produced the previous season. Prune to

Mature olive tree is ornamental and productive.

Peaches require severe pruning during training to develop a strong, healthy tree. Here are results of hard work.

remove wood that has fruited. Pruning stimulates production of new fruiting wood. Prune in years of potentially heavy crops after fruit has set in spring or early summer. Thinning to renew fruiting wood and improve light penetration is helpful. Don't prune too heavily because trees may become vegetative and produce few olives.

PEACHES AND NECTARINES
Prunus persica

Training Young Trees—Peach and nectarine trees require more severe pruning for training than any other kind of fruit tree. Trained to a central leader, these trees may overgrow in the top and lose lower limbs due to shading. Y-shaped two-leader trees are practical and may fit limited spaces better than trees with more limbs. Three-leader trees are strong and easy to care for. Trees with four or five leaders definitely have too many leaders. Genetic dwarfs require thinning to four or five scaffolds with little other training.

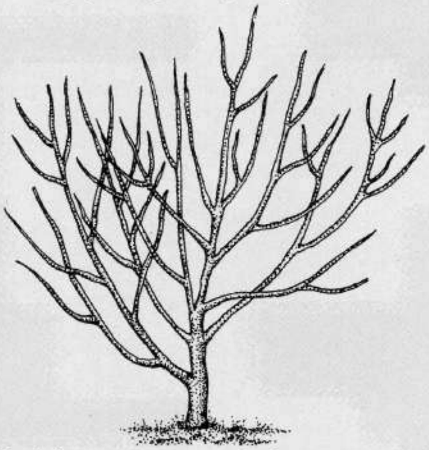
Head young peach and nectarine trees 6 inches above ground at planting if you want a short tree. Head up to 2 feet above ground for gardening space underneath. Central-leader trees can be developed without heading, but all side limbs must be removed.

After heading at planting, shorten side shoots to 2 or 3 inches where you want a scaffold branch. Remove all others. Space scaffold limbs evenly around the trunk and several inches apart vertically. Scaffold spacing is

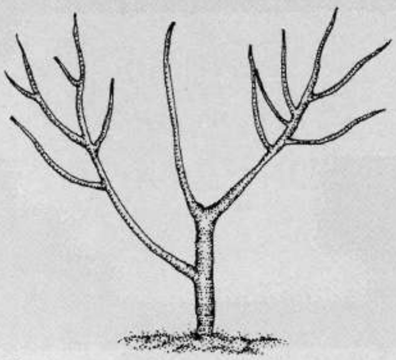
This peach tree has been well-pruned. It will require little support for a heavy fruit crop.

TRAINING YOUNG PEACH TREES

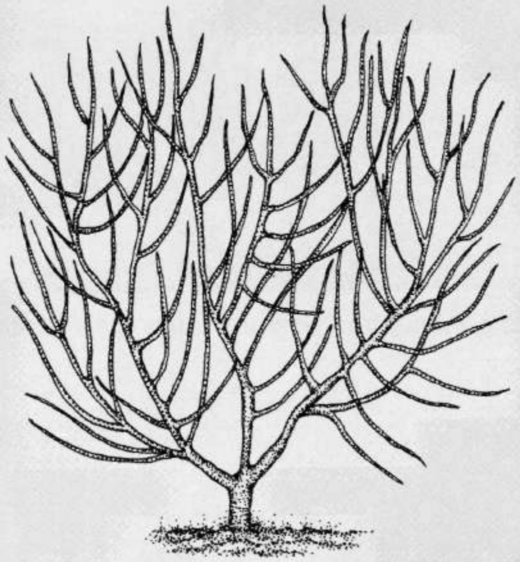
During the first two dormant seasons, peach trees require heavy pruning. Pruning helps trees develop a few, strong scaffold limbs for supporting heavy crops.



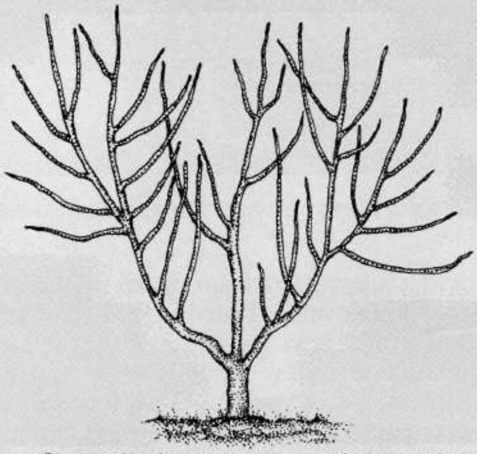
First dormant season, before pruning.



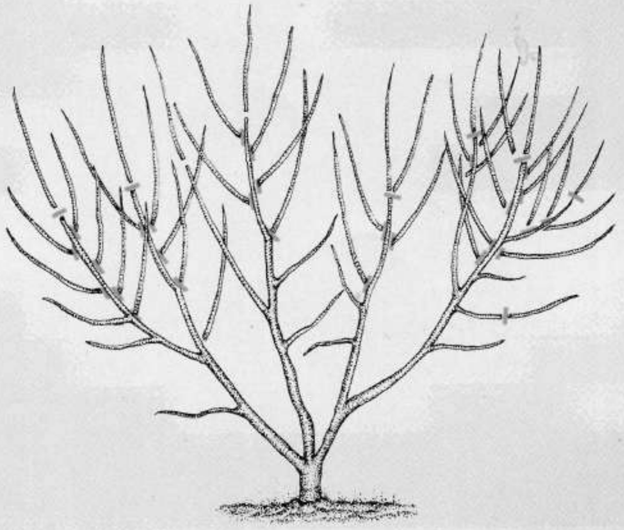
First dormant season, after pruning.



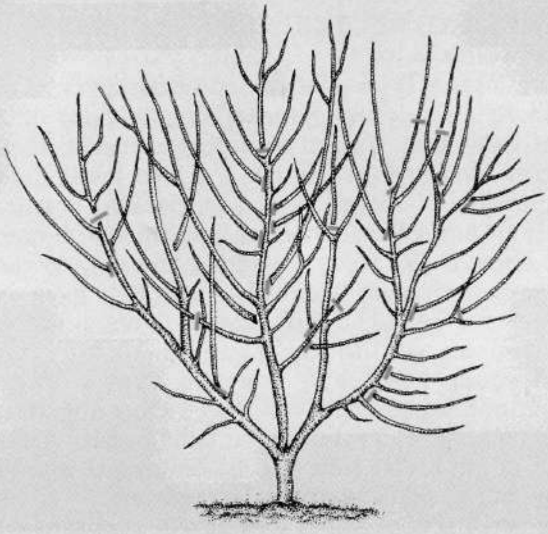
Second dormant season, before pruning.



Second dormant season, after pruning.



Third dormant season. Thin and head to develop strong secondary and tertiary scaffold limbs.



Fourth dormant season. During this and following seasons, thin and head to develop strong fruiting wood.

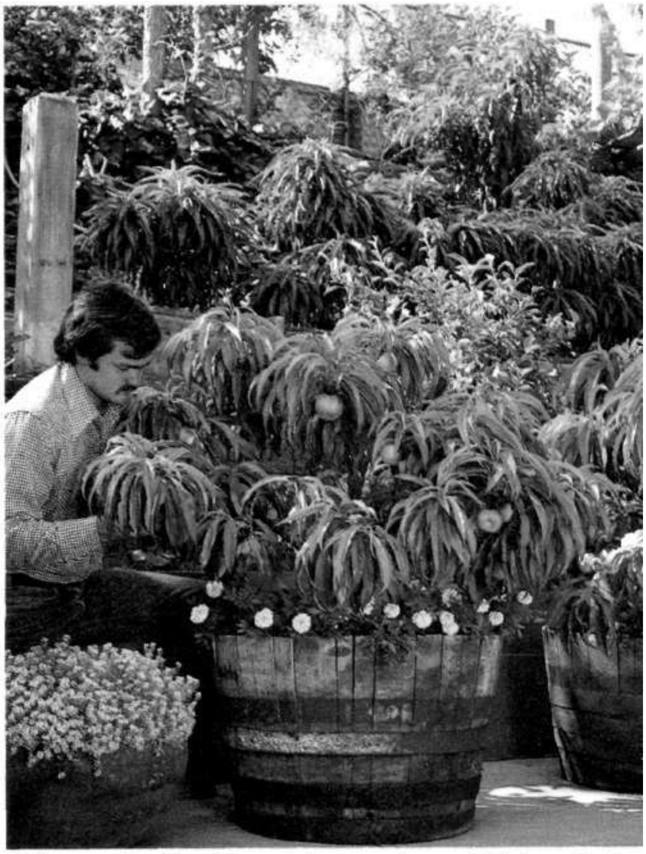
important because peach trees tend to have weak crotches. These crotches break if limbs originate at the same height on the trunk.

Pinch unwanted shoots in summer to direct most new growth into scaffolds. During the first dormant season, head scaffold limbs at 24 to 30 inches away from the trunk. Heading stiffens scaffolds and ensures development of strong secondary limbs.

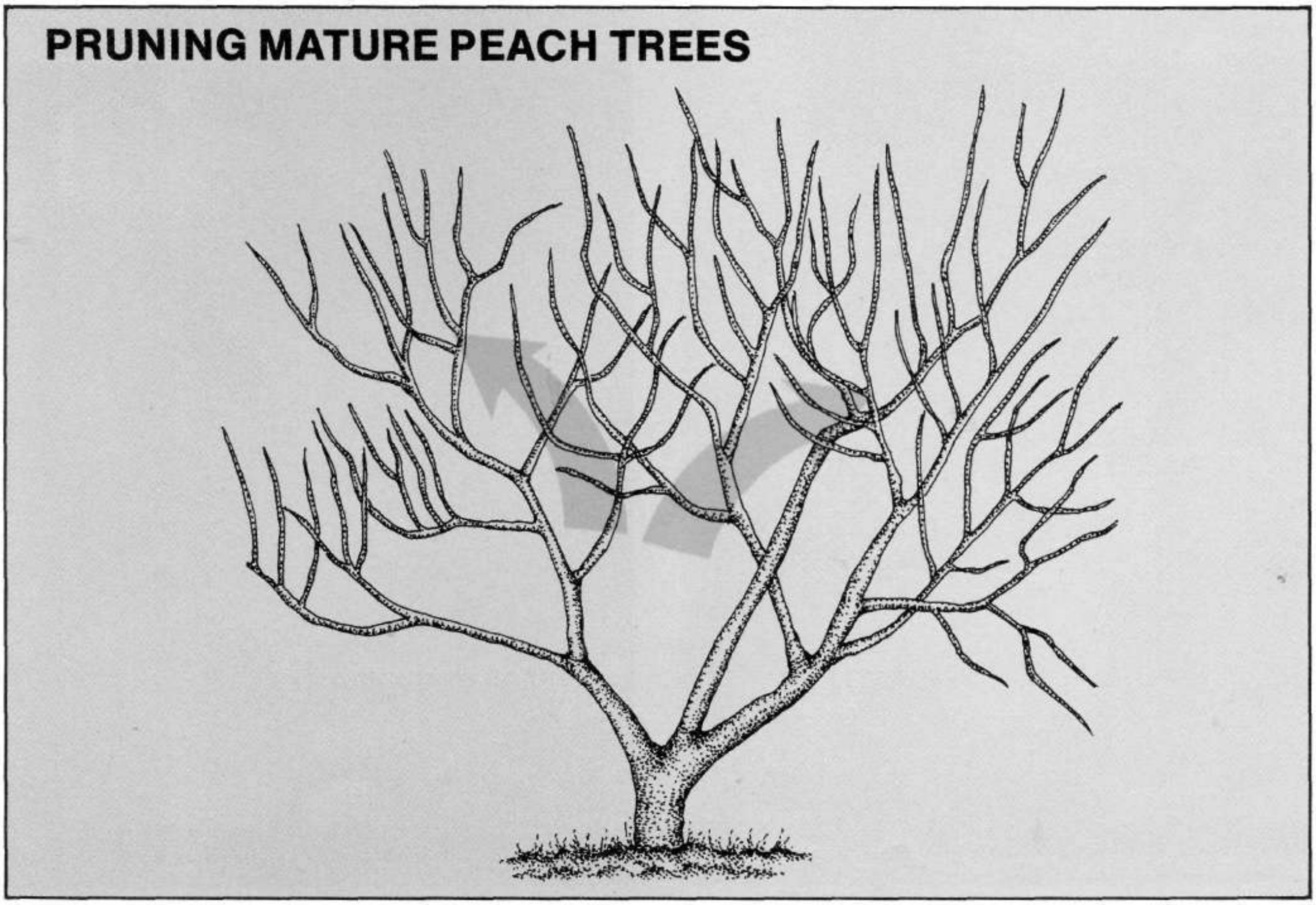
Remove all vigorous shoots that compete with secondary scaffolds. Thin shoots again in the second dormant season and develop secondary-scaffold limbs. In the third dormant season, thin fruiting wood to prepare for next summer's fruiting. Favor the outward-growing wood so sunlight can reach into the tree's center.

Pruning Bearing Trees—Because peach and nectarine trees bear only on previous-season's wood, trees must be pruned extensively every year. Heading upper, outer shoots in midsummer to late summer helps bring sunlight to lower limbs and prevents dieback from shading. During the dormant season, remove fruiting shoots. Cut back to shoots of medium vigor. Prune to counteract strong tendency of fruiting wood to move upward and outward, away from the trunk.

Remove or thin strong-growing shoots in the tree top. Thin these shoots back to more upright shoots. Upper, outermost branches tend to spread too far apart. Thin weakest shoots, leaving shoots of pencil-thickness far enough apart for good light distribution and fruit production.



This genetic-dwarf peach tree produces delicious fruit.



Severely prune mature peach trees to renew fruiting wood each year. Pruning also counteracts the tendency for fruiting wood to migrate away from the trunk. Arrows indicate direction of migrating fruiting wood.

Remove more wood from early maturing varieties than from later-maturing varieties. Clingstone peaches may be allowed more fruiting shoots than freestone peaches. Leave more fruiting wood in rainy regions of the country where fruit-set is likely to be light. Head longest shoots back to 2 feet or less, especially when excess shoot growth is a frequent problem.

PEARS

Pyrus species

Training Young Plants—Pears can be trained to a central-leader, multiple-leader, espalier or palmette. Central-leader trees are likely to be damaged severely by a disease called *fireblight.*

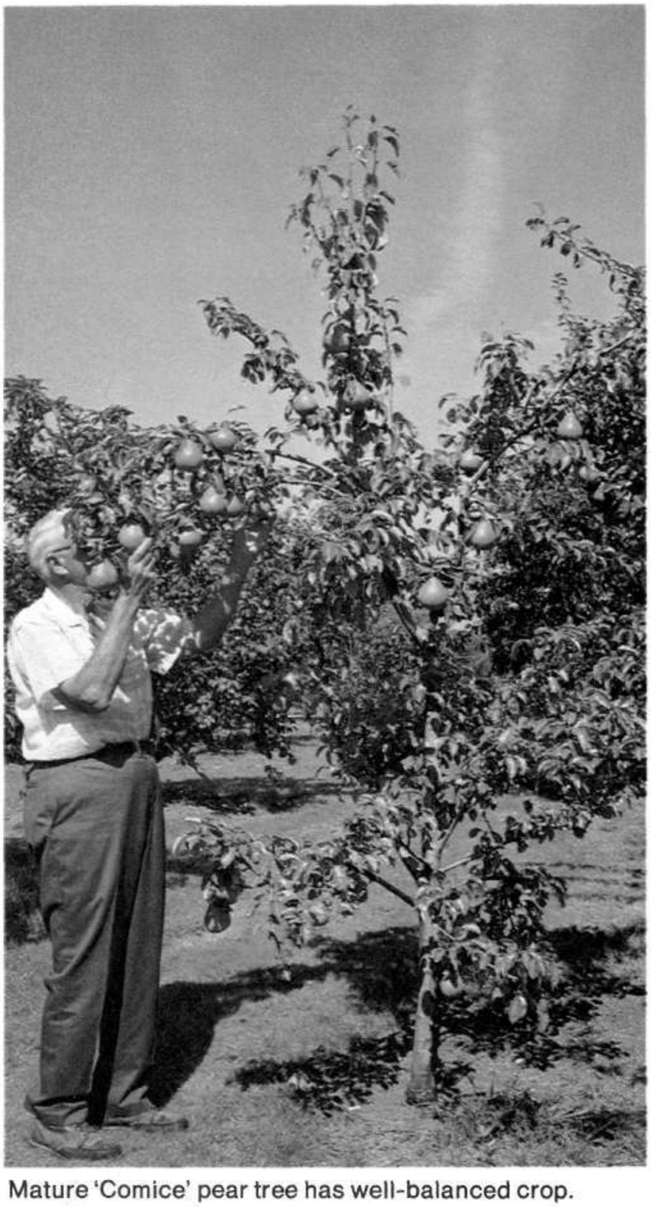
Bartlett pears have soft, flexible wood that bends down easily with the weight of leaves. This makes central-leader training difficult because limb-spreading must be followed promptly by tying-up of limbs. Other varieties of European pear are more easily grown as central-leader trees.

Head pear trees 24 to 30 inches above ground at planting. Select three well-spaced scaffold limbs. Shoots below these limbs can be left to fill in the bottom of trees. Remove any shoots between scaffold limbs. The central leader may be kept for one or two years to help spread permanent scaffolds. The central leader should be suppressed and eventually removed.

Head scaffolds each year at 2-1/2 to 3 feet above previous year's heading. Do not head side shoots. If leaders are growing rapidly, summer pinching can stimulate branching. Tie or strap scaffold limbs together to prevent breakage while limbs are young and flexible.

Pruning Bearing Trees—Pears bear on long-lived spurs. However, pear trees generally require heavy pruning to stimulate fruit-set.. This is particularly true if there has been no provision for cross-pollination. Fruit-set is usually extensive on young spurs on 2- or 3-year-old wood. Don't head shoots unless shoots are over 2 feet long. Remove or head shoots to about 18 inches in length.

Head shoots to flower buds on 2- or 3-year-old wood. Remove wood that fruited heavily in the previous season. Leave a well-positioned, 1-year-old shoot to replace the wood removed. Remove water sprouts and suckers to replace fruiting wood.


Mature 'Comice' pear tree has well-balanced crop.

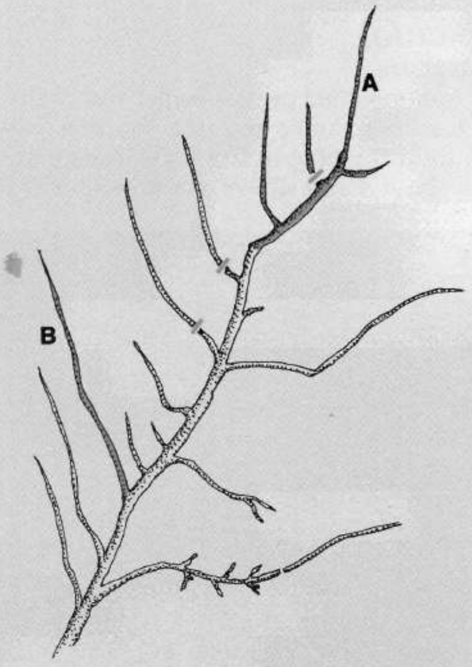
PECANS

Carya illinoinensis

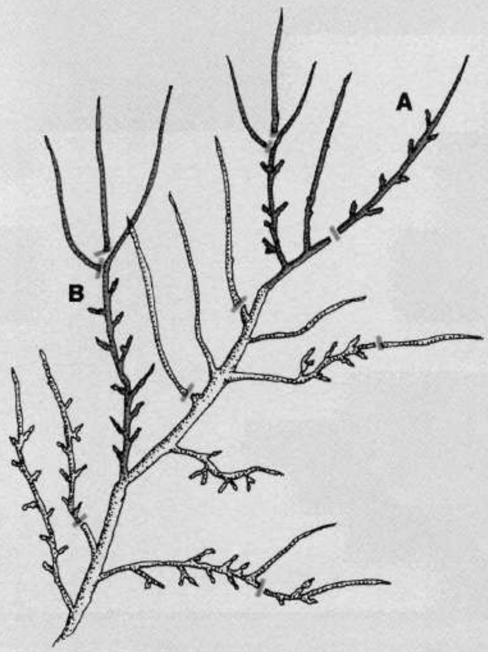
Head at planting time to about 4 or 5 feet. Remove about 1/3 of the top, depending on size of the nursery tree. Limb breakage can be a problem because of narrow crotches and brittle wood.

'Comice' pear.

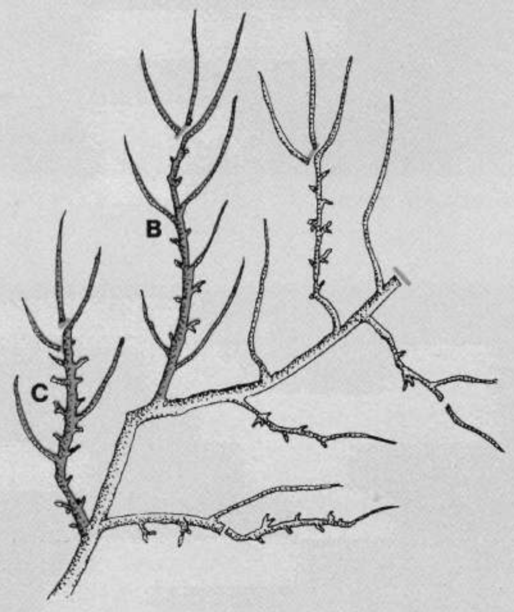
LEADER DEVELOPMENT IN YOUNG, BEARING PEAR TREES



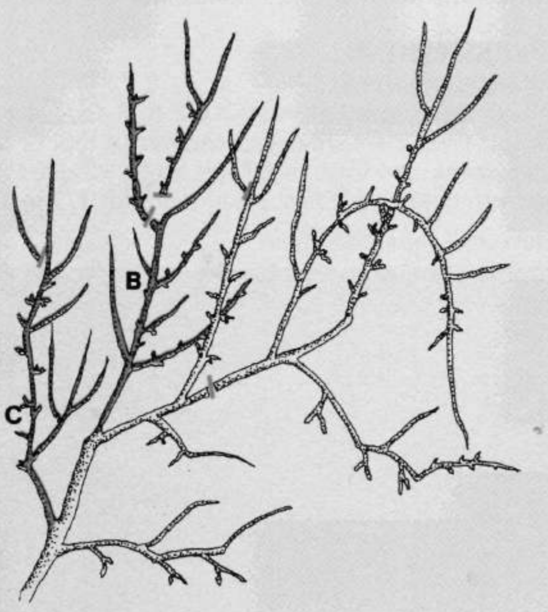
Scaffold limbs are pulled outward by fruit. Thin shoots and locate leader A and renewal leader B.



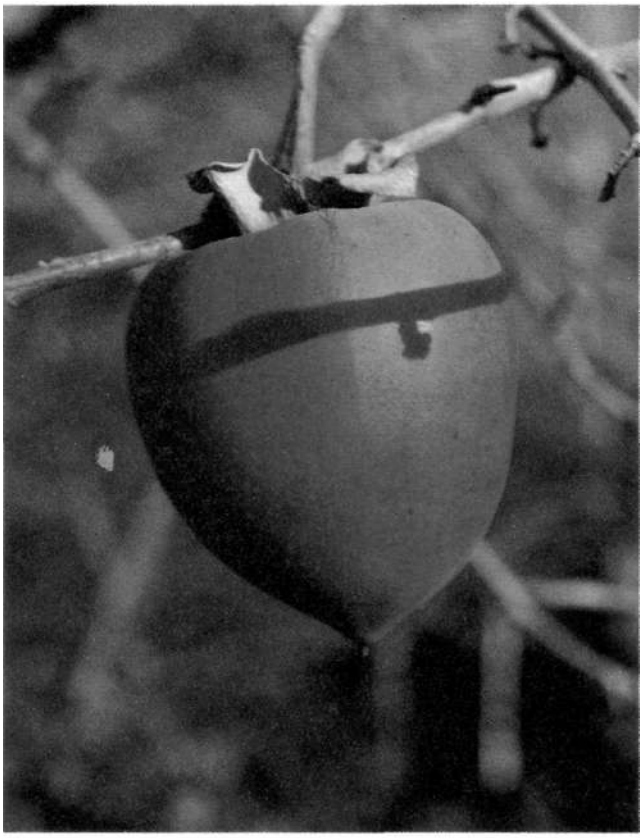
Following season, remove water sprouts and fruiting wood. Thin to single, upright shoots. Remove leader A.



Following season note dominance of renewal leader B. Branch C will become the new renewal leader.



Remove outward fruiting wood to establish dominance of leader B. Renewal leader C will soon replace leader B.



Colorful 'Hachiya' persimmon fruit.

Train pecans to a central leader, avoiding narrow-angle crotches. Head scaffold limbs to stiffen and strengthen. Prune lightly the first five or six years. Remove limbs that are crowded, have poor angles, are too low or compete with the leader. Mature trees need little or no pruning except to remove low limbs.

PERSIMMONS
Diospyros species
Head the nursery tree at 2-1/2 to 3 feet at planting. Select five or six shoots spaced over a foot or more up the trunk to form scaffold limbs. Suppress other growth below scaffolds. Head scaffolds 1/3 to 1/2 after the first growing season. Avoid further pruning until the tree begins to bear fruit. Remove occasional crossing or poorly placed limbs.

Bearing trees require little pruning. Thin to more upright shoots to lighten branch ends. Thin out tops of old, weak trees to let in sunlight and stimulate growth.

PISTACHIO
Pistacia vera
Train to a modified central leader with well-spaced lateral branches. Stake the tree the first two or three years. Develop three to five main leaders with the first leader about 4 feet above the ground and the others

'Brooks' European plum.

'Satsuma' Japanese plum.

spaced at about 1-foot intervals. Pinch off undesired growth the first few years. Avoid large wounds. Wounds heal slowly. Trees bear on wood formed the previous year. Pistachio trees are slow growing. Little pruning is required to contain them. Male trees are required to pollinize female trees. Male trees are vigorous and may need more pruning than female trees.

PLUMS and PRUNES
Prunus domestica, P. salicina

Training Young Trees—Plum and prune trees are trained to a multiple leader with three or four main scaffold limbs. Head trees at 18 to 24 inches at planting and select shoots to be leaders. If shoots are upright with narrow crotches, use spring-type clothespins to spread limbs during the first growing seasons.

Most European plums—some are *called prunes—require* only one light heading of scaffold limbs about 2 to 2-1/2 feet from the crotch to stimulate branching. These plums bear heavier and earlier if they are pruned lightly instead of heavily.

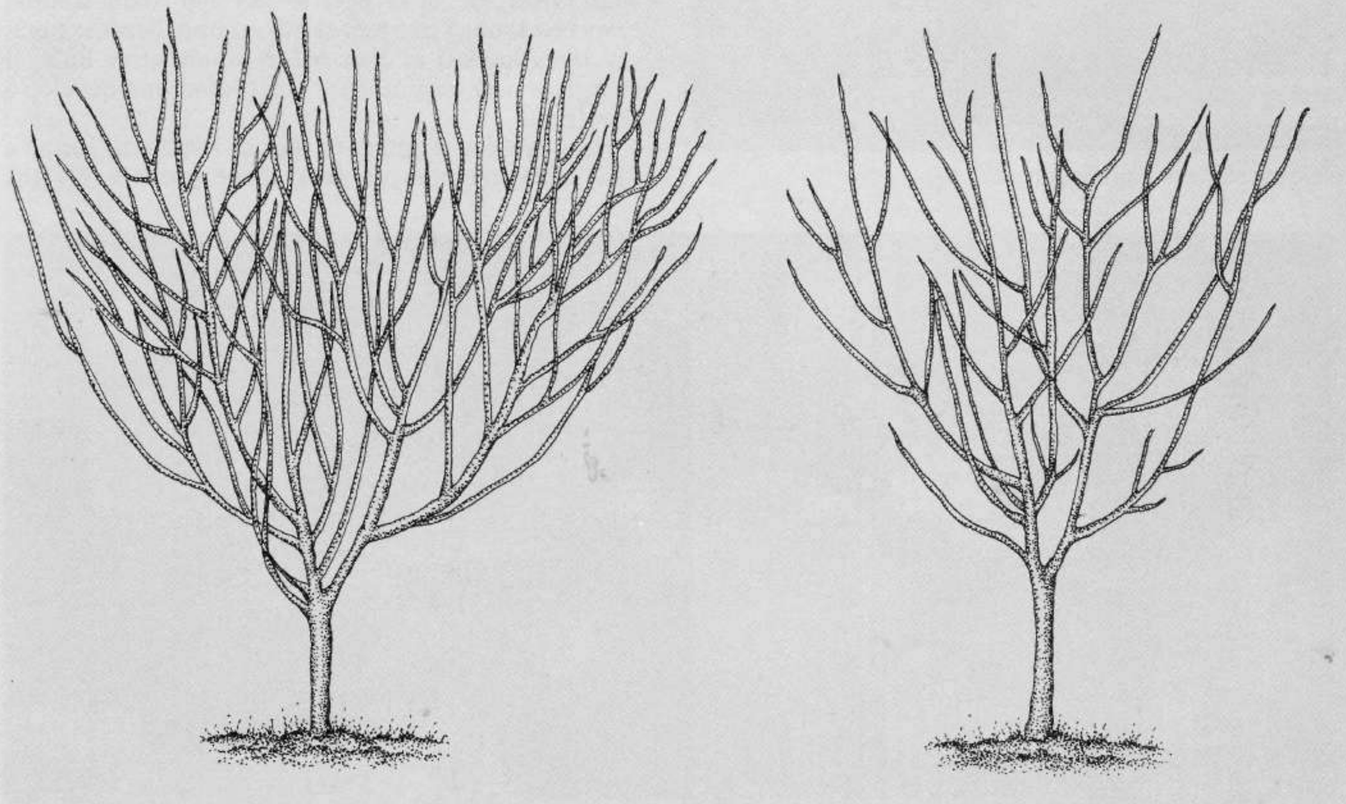
Japanese plums require more severe heading of scaffold limbs to stiffen limbs and promote branching. Thin to keep outside spreading limbs. Avoid severe *bench-cutting* because this pruning method weakens scaffolds. Bench-cutting is a method of spreading trees by heading leaders to outward-growing shoots. Keep secondary branches that are well-positioned. Head primary scaffolds just above secondary branches. Head at 24 to 36 inches from the crotch to stimulate branching.

During the third dormant season, thin *tertiary* or third-year scaffolds to one or two per secondary. Because Japanese plums tend to be narrow and upright, it helps to thin interior shoots to spread the tree.

Pruning Bearing Trees—Prune European plums to lighten branch ends as needed to prevent breakage. Fruiting wood renewal comes from long water sprouts. These water sprouts arise on the upper side of arched fruiting limbs. Cut back to the arch on these limbs to reduce tree height and renew fruiting wood.

Pruning mature Japanese plums consists of thinning out 1-year-old shoots. Leave some 1-year-old shoots to renew fruiting wood. Remove a few branches carrying old, weak spurs.

PRUNING A JAPANESE PLUM TREE



After two years of no pruning, this Japanese plum is too dense by the third dormant season.

After pruning, excess shoots have been removed. Remaining shoots will grow strong.

'Wonderful' pomegranate fruit.

POMEGRANATES
Punica granatum

Pomegranates may be pruned to bushes, or to single-trunk or multiple-trunk trees. Bushes are easier to maintain because pomegranates produce many basal suckers. A single trunk is likely to be killed in a freeze, but some of the multiple trunks could survive. If one or two trunks are lost, new ones can be developed from suckers.

Bearing trees require annual thinning to keep them open for harvesting and to renew fruiting wood. Light, annual thinning leaves slow-growing mature wood with flower spurs and maintains production. Remove basal suckers annually.

QUINCE
Cydonia oblonga

Quince can be trained as shrubs or small trees. Multiple-leader trees with four main scaffold limbs are easiest to manage. Head young trees at 18 to 24 inches. Space branches about 6 inches apart.

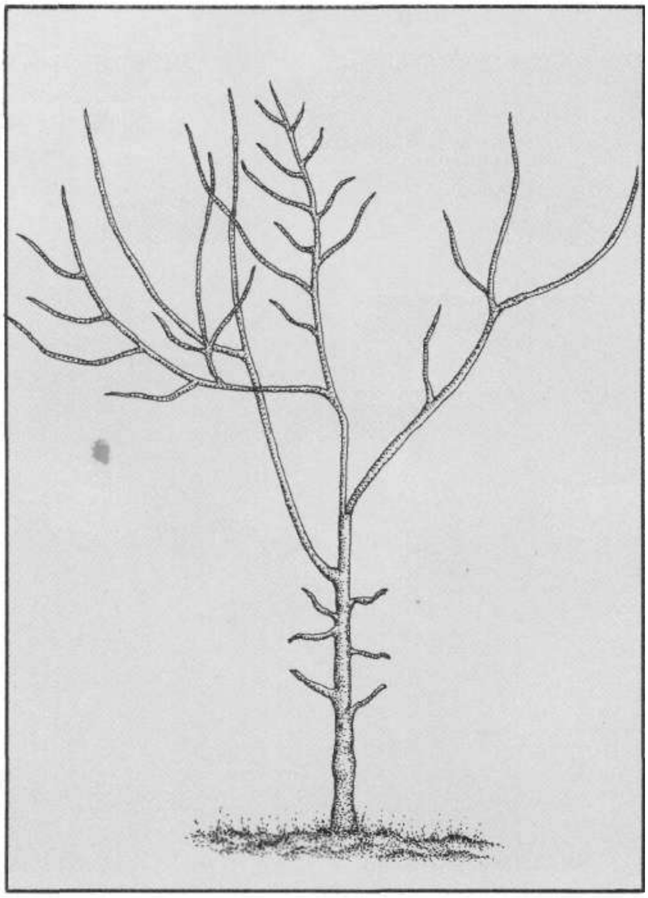
Quince fruit is borne terminally on shoots that grow the same year. Thin branches to improve penetration of sunlight and chemical sprays. Do not head shoots.

WALNUTS
Juglans species

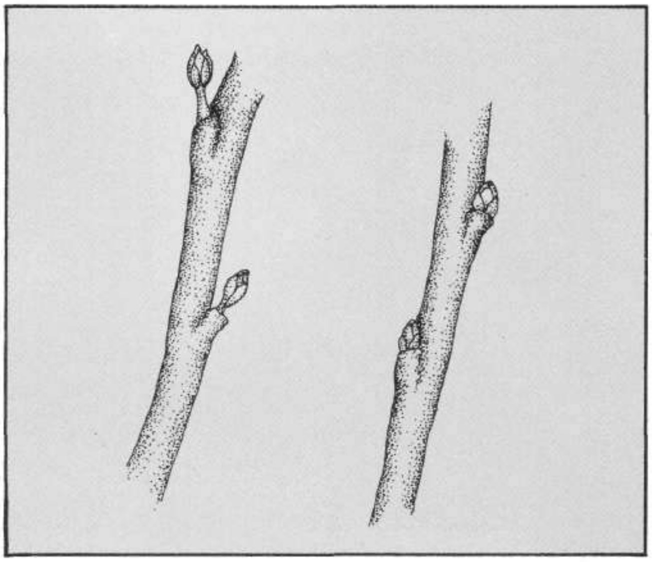
Training Young Trees—Walnut trees are large and wide-spreading. It is best to develop main scaffold branches about 5 or 6 feet above ground. Because nursery trees headed at 5 or 6 feet would grow little, if ever, it is necessary to head trees lower and develop a new trunk.

Head trees at planting to four or five buds. Install a 2x2 stake extending 6 feet above ground. Tie the

Immature English walnuts.



Walnut trees should be trained to a modified-leader system. After 4 years of training, tree should look like this. Note stubs left to shade trunk.



It is important to avoid scaffold development from necked-buds on walnut trees. Scaffolds should not be developed from buds shown at left. The closely attached buds on the right will produce strong scaffolds.

Wide-spreading, mature walnut tree provides shade and nuts.

leader loosely to the stake. Pinch back all shoots that compete with the leader.

After the first growing season, head the leader about three buds above the stake. Remove all side limbs. Break off buds on short stems or "necks." Removing these necked buds lets strong scaffold limbs form from secondary buds below. Limbs formed from necked buds have weak crotches and break off easily. If the leader didn't grow enough, head back the leader to last season's growth. Continue to train this leader in the second summer. Keep the leader staked up through the second summer.

In the second dormant season select four to six scaffold limbs at 5 to 7 feet above ground. Choose limbs with wide-angle crotches. Avoid limbs that are completely horizontal. Remove lateral branches below the lowest scaffold limb. Branches lower on the trunk should be cut to short stubs.

Heading of scaffolds is not necessary with tip-bearers such as 'Franquette' and 'Hartley'. Heading is important with newer varieties that bear laterally. Head scaffold limbs of 'Amigo', 'Chico', 'Payne', 'Serr' and other heavy bearers 1/4 to 1/2 during the first dormant season. Prune and head scaffolds each season.

Careful attention to this training procedure is necessary to obtain a structurally strong walnut tree.

Pruning Bearing Trees—Young, bearing walnut trees usually do not need pruning. Some new, heavy-bearing varieties stop growing or break apart if shoots aren't headed 25% to 50% annually. As trees mature and foliage becomes dense, all varieties benefit from thinning to let light into the canopy. It is difficult for the average homeowner to prune mature trees 25 to 35 feet tall. You may need to call in a professional to care for mature walnut trees.

SPECIAL TRAINING PROCEDURES

Fruit trees can be grown successfully as espaliers or hedges that create garden dividers and boundary plantings. These special training techniques save space and allow the home gardener to grow more varieties than would otherwise be possible. This section details the use of dwarfing and training to confine fruit trees within small spaces.

Growing fruit in tight spaces is really no harder than maintaining a healthy rosebush, but keep the following points in mind.

1 Be especially careful about planting and general maintenance.
2 Prepare your soil well, and where drainage is a problem, use low raised beds.
3 Feed and water on a regular schedule, and keep a careful watch for signs of any insects or diseases.
D Don't let new growth escape from you and spoil the pattern.
4 Inspect your plants frequently

In limited-space planting, training continues all seasons throughout the life of the plant. Be ready to pinch or snip at any time. Major pruning is still a winter task, but in summer you will need to head, or cut away wild growth and suckers, and you may need to loosen or renew ties or add new ones.

Be sure you understand the normal growth patterns of the plants you intend to train. For example, apples and pears bear fruit in the same places for years. Although fruiting spurs may need to be renewed over the years, the growth pattern means that you can confine these trees to formal shapes and keep them that way

On the other hand, peaches and nectarines fruit on branches that grew the previous year. Old branches will not bear, so they should be cut away like berry canes and replaced with new growth from the base of the tree. This heavy pruning makes rigid training patterns impossible. Peaches and nectarines can be fanned out over walls or grown as hedges, but they cannot be held to strict geometric shapes.

Grapes are vines and therefore are almost always trained on a wall, wire, or fence. See Training Grapes on page 52 for instructions. A variety that requires a little more heat than your region normally offers may produce good fruit when grown on a south or west wall.

These apples are in their third year of training as a hedge. Because hedge training is less structured and formal than is espalier training, it is a little simpler.

You can train cane berries flat against fences or walls, and treat them something like peaches, since you must replace all canes that have fruited with canes of the current season.

The poorest subjects for limited space training are the quince and cherry The quince fruits at the tips of new twigs, and the cherry is normally too large to confine and will not fruit at all without a pollinator close by Both of these plants can be trained, but your efforts would be better spent on something more rewarding.

Espaliers

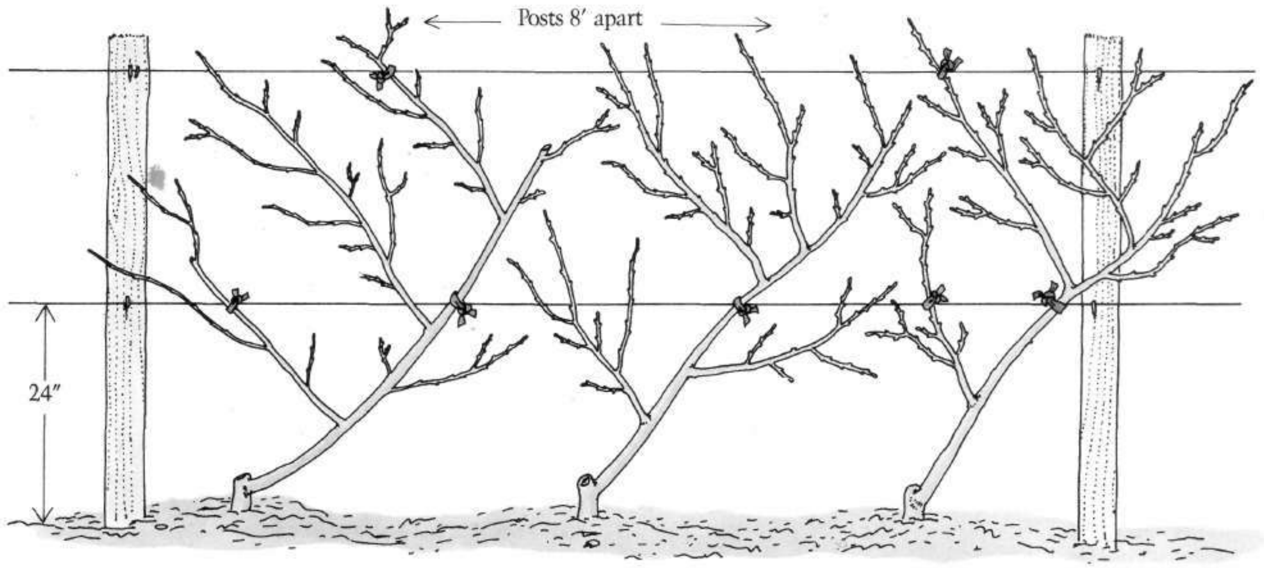
Technically speaking an espalier is a plant pruned to grow all in one plane. Most often, a symmetrical pattern is established through careful pruning and training. Supple young branches are fastened to a fence, a wall, or wires with soft string or bands of rubber. Plants trained against a wall should be at least 6 inches away from the wall to allow good air circulation and room to grow.

Espaliers usually require the formation of *cordons—side* arms—off a main trunk. Cordons should be spaced no less than 16 inches apart to allow for optimal growth.

A word of caution: Where summer temperatures reach 90° F or more, heat from the wall will cook the fruit. In this situation, espalier a tree onto a free-standing trellis for better air circulation.

Training Apples and Pears

Both apples and pears can be grown as hedges.



Apples and pears as espaliers Of all the fruit trees, apples and pears are really the best suited for this specialized training. Run horizontal wires 18 inches across a wall or between two posts. Plant a bare-root whip, then cut it off at 18 inches, at or just below the height of the first wire. This will activate the buds just below the cut.

The first summer, train two side buds onto the wire, letting a third bud develop as a trunk. Tie the two side branches onto the wire so that the tips are lower than the branches. Rub off all growth from the trunk and prune the tips and the branches.

Next winter, cut the trunk off a little below the second 36-inch-high wire. This will activate another set of buds. Again, keep two buds for side branches and one for the trunk extension. Train these as you did the first set of buds. Cut the laterals on the branches on the first wire back to three buds. These will develop into fruiting spurs.

Continue training until three wires (or as many as you wish) are covered with branches. On the top wire there will be no trunk extension, just the two side branches.

Hedges

Home gardeners are not the only ones concerned with limited space planting. Commercial growers are experimenting with training methods that let them grow fruit in hedgerows and harvest their crops without ladders.

Apples and pears as hedges Both dwarf apples and pears grow and fruit well when trained as hedges against horizontal wires. Set posts about 8 feet apart. Stretch a bottom wire between the posts 24 inches above the ground. For very small trees, place the upper wire at 4 or 5 feet. For larger trees, place a third wire at 6 or 7 feet.

Plant the young bare-root trees about 3 feet apart, beginning next to an end post. The last tree should be placed about 2 to 3 feet short of the final post. If you buy unbranched trees, bend the trunk at a 45-degree angle and tie it to the wire. If there are any branches with wide crotches, cut them so only two leaf buds remain. Clip off branches with narrow crotches at the trunk.

During the first season, train the trunk and any new branches at about 45 degrees, tying loosely where they touch the wires. Pinch off at the tip any branches that seem badly spaced or that extend from the fence at right angles. The first winter remove badly placed branches at the trunk. Remove the tips from well-placed branches, cutting to a healthy bud on the top of each branch.

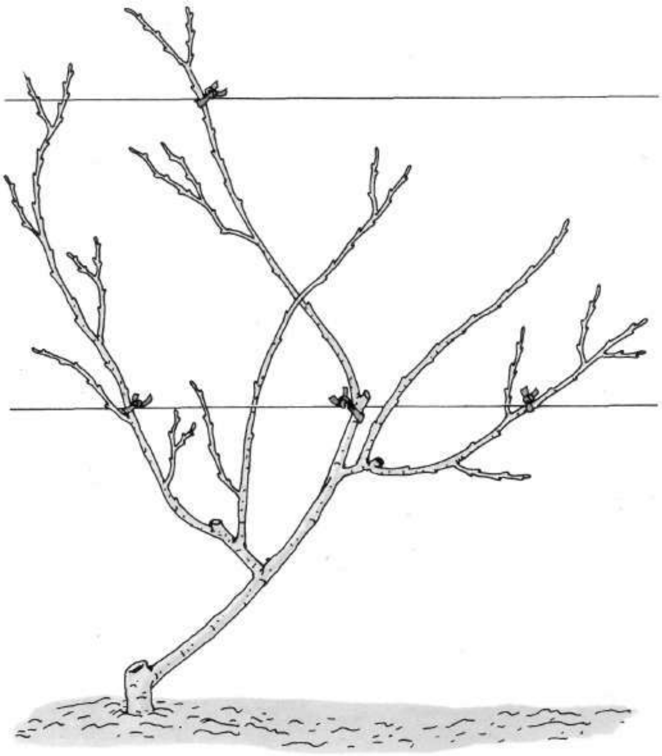
The second summer continue training the shoots at the ends of branches upward at a 45-degree angle. Cut side growth to four buds beginning in July

Each winter thereafter remove tangled or damaged growth and cut remaining long shoots to four leaf buds. Each summer cut out suckers and excessively vigorous sprouts as they appear. Shorten new growth to four leaves after July

This training method allows side branches to grow outward away from the fence. Your hedge will eventually become 3 to 4 feet wide. You can hold it at that width by pulling some of the outward growth back toward the fence with string, but check ties frequently or they will cut the branches. If parts of your hedge begin to escape and grow too far outward, trim them back to healthy side branches in May To maintain the proper height of 5 to 8 feet, cut top growth back to a healthy side shoot in May Make the cut close to the top wire.

Training Peaches and Nectarines

Each year cut out branches that have fruited, letting new branches replace them to bear next year's fruit.



Peaches and nectarines as hedges Since a peach hedge must have its fruiting wood renewed annually, you will need long replacement branches each year. Plant your hedge as described for apples, using wires at 2, 4, and 6 feet. Cut the whips to about 24 inches tall, and shorten side branches that point along the fence to two buds each. Cut off other branches at the trunk. Train all new growth at 45-degree angles in both directions. Remove any suckers from below the bud union, cutting to the trunk.

The first winter cut out about half the new growth at the base, choosing the weakest branches for removal. Cut off the tops of branches you retain if they have grown beyond the hedge limits.

Fruit will form on the branches that grew the previous summer. The original trunk and the lowest branch will form an approximate V shape at or below the lowest wire. During the second summer, choose the healthiest shoots from the lower portions of these main branches, and pinch back all other growth—especially above the second wire—after it produces six to eight leaves. The lower shoots will replace the entire upper structure and should be tied back loosely to the fence. Continue to remove suckers below the bud union.

When leaves drop in fall, cut out all branches that have fruited, and head back the V-shaped main structure to the middle wire. Train the new growth to the fence. During the summer again encourage the lower shoots and pinch back the upper growth. Always be sure that there is new growth above the bud union.

Apricots and plums as hedges Use approximately the same technique as described for peaches, but instead of replacing all growth each year replace about one-third and head back new growth on the remaining branches to four to six leaves.

Planting and Caring for The Home Orchard

Learn the principles of fruit growth and apply them when caring for your home orchard. If you follow the planting, feeding, and watering instructions in this chapter, you'll get maximum production from your garden.

The art of growing abundant fruit lies in selecting the right varieties for your region, then growing them with informed skill. This chapter discusses how fruit plants produce fruit, how they grow, and tells you everything you need to know to get them started and keep them healthy and productive.

Every time you bite into an apple or pear, you're tasting the results of plant breeding, particularly the act of pollination. With a few exceptions (certain figs, for example), fruit will not form unless pollen from the male parts of a flower is transferred to the female parts of a flower. The pollinating insects for most of the fruits in this book are bees. The presence of bees around your plants, however, does not necessarily mean you'll get a crop. The pollen the bees carry must be of the right sort. Most of us know that apple pollen, for example, will never pollinate a pear blossom; it's also true that apple pollen will not always pollinate an apple blossom.

The same sweet goodness that attracts us to fruit attracts a wide variety of insects. A few well-timed sprays, however, protect your fruit against unwelcome guests.

To get a crop from most fruit trees, you need a separate source of pollen and a bee to carry it.

POLLINATION REQUIREMENTS

Some plants are called *self-pollinating* or *self-fertile.* This means that their flowers can be fertilized by pollen from flowers either on the same plant or another plant of the same kind. Self-fertile plants will produce fruit even if they are planted far away from any other plant of their kind. Among the self-fertile plants are a few types of apples, pears, and plums; most peaches, apricots, and crabapples; and all sour cherries.

Other plants set fruit only when they receive pollen from a plant of a different variety When a plant's pollen is ineffective on its own flowers, it is called *self-sterile.* This group includes some peaches, apricots, and crabapples, most apples, pears, and plums; and all sweet cherries. The plant that can fertilize a sterile plant is called a *pollinator*

Never assume that because you have a

Planting for Pollination

A fruit plant that needs a pollinator needs it close by The maximum distance is 100 feet, but the closer the better. The bees that carry the pollen are unlikely to fly back and forth if the distance between the trees is any greater.

If your neighbor has a pollinating variety across the back fence, you're in good shape; if not, do one of the following.

1 Plant two trees fairly close together.

2 Graft a branch of another variety onto a tree that needs pollination.

3 Place a bouquet of flowers from a pollinating tree in a vase or jar of water and lodge the container in the branches of a second tree.

The "Encyclopedia of Fruits, Berries & Nuts," beginning on page 59, will tell you which varieties need pollinators and which varieties act as pollinators.

HOW FRUIT PLANTS GROW

All plants must have sugar to produce energy and grow. They make the sugar through photosynthesis. You can stimulate this process by planting them in a sunny spot; pruning and training them for good leaf exposure; keeping the soil properly watered; and keeping leaves free of dust, pests, and disease. Each piece of growing fruit needs some 30 leaves working for it, not including the leaves that supply nourishment to roots and branches.

The illustration on the opposite page gives you some idea of the day-to-day workings of a fruit plant. While the leaves are busy above ground, the roots spread out underground searching for water, oxygen, and mineral nutrients. These essential elements are then transported to the green leaf tissues where photosynthesis is carried out using the energy supplied by sunlight to manufacture needed sugars. The sugar not immediately converted to usable energy for the plant's growth is stored throughout the plant, including the fruit. It's easy to understand that the greater the supply of factors that produce sugar—sunlight, water, and carbon dioxide—the more abundant and sweet the fruit.

SOIL

Roots depend on the soil for a good supply of air and consistent moisture. The best soil for fruit trees allows air into the soil quickly after a rain or irrigation and holds much water.

Heavy soils are soils that drain slowly. You can improve them for fruit trees by adding plentiful organic matter, and by planting high, so the tree sits on a low mound.

Some fruits, such as pears, will tolerate dense, airless, heavy soil. Apples and crab-apples will take short periods of airless soil, but apricots, cherries, figs, plums, grapes, and currants all need fair drainage. Strawberries, cane berries, and peaches need good drainage, and blueberries must have perfect drainage.

In gardens with extremely heavy soil, you can still plant fruits that prefer porous soils by using containers or raised beds. A raised bed for a standard fruit tree should be 3 feet deep and 6 feet square. Soils for containers are discussed on page 26.

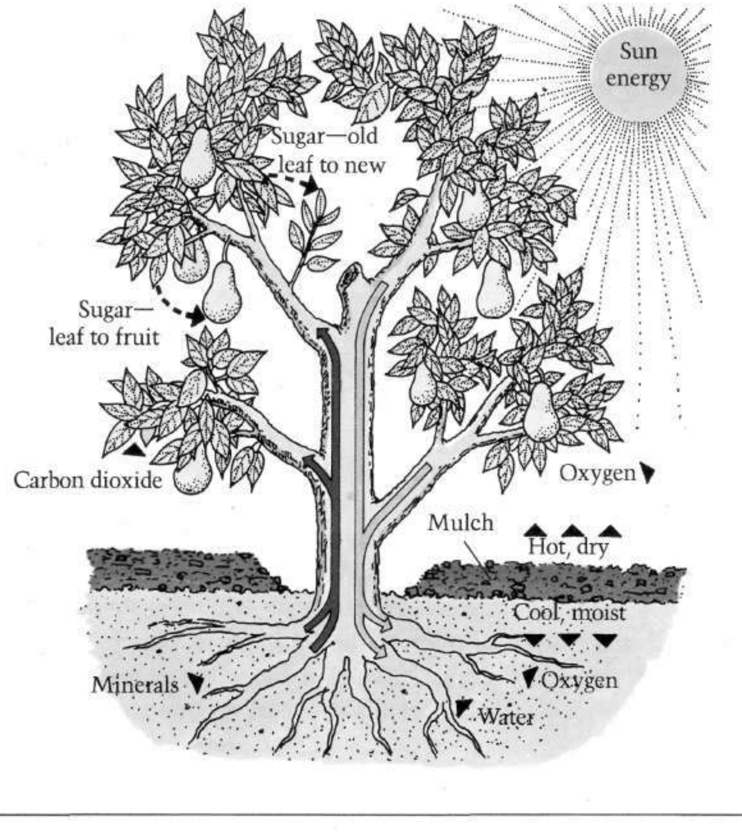
Soils that don't hold much water are called *droughty*. They are most easily improved by adding large amounts of organic matter. The organic matter acts like a sponge, holding water until the tree needs it. Most fruit trees can be grown on droughty soil, but they should be watered and fertilized more frequently than trees on better soil.

You can supply these needs best if you first examine your soil. If it is rock hard when dry and gummy when wet, you have the very fine-textured soil called clay. Clay holds moisture so well that there is little or no room for air. To correct this, aerate clay soil by adding organic matter such as peat moss or compost. Spread 4 or 5 inches of organic matter over the soil and mix it in evenly. Ideally you should add organic material wherever the plant's roots might spread at maturity; the roots spread more widely than the branches.

If water soaks directly into your soil without significant spreading and the soil dries up a few days after watering, your soil is sandy. Sandy soils contain a great deal of air, but moisture and nutrients wash away quickly. Additional organic matter helps here, too, by filling in spaces between the coarse soil particles and retaining the water. Peat moss, compost, and manures are especially beneficial to sandy soils. You can also use sawdust or ground bark, but with these you must add extra nitrogen—1/4 pound ammonium nitrate, or equivalent, per bushel—or the soil microbes will rob nitrogen from plants as they convert the sawdust or bark into humus.

If you have soil that feels moist for days after watering, but still crumbles easily when you pick up a handful and squeeze it, you are blessed with loamy soil and shouldn't need to amend it.

Day-to-day Workings of a Fruit Tree



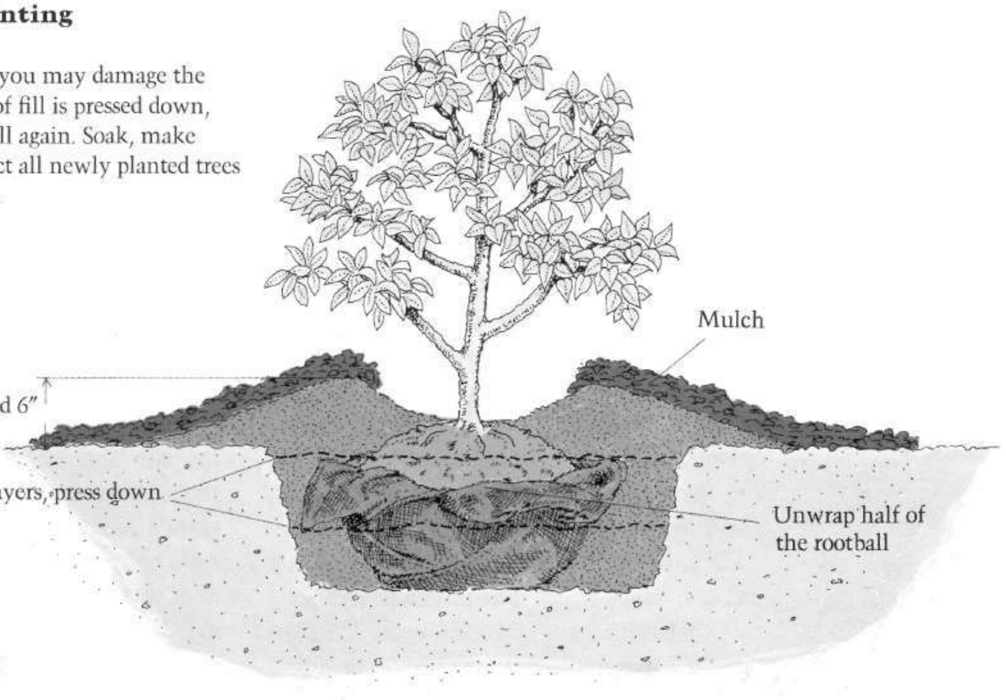
PLANTING

Nurseries and garden centers sell plants in three ways: bareroot, balled and burlapped (with the rootball wrapped in burlap), or in containers.

Most deciduous fruit plants are sold bare root. The leafless plant is taken from the ground in late fall or winter after it has gone dormant and it is then shipped to the nursery where it is held in moist sand or wood shavings. Sometimes the roots are enclosed in a plastic bag full of damp shavings. Bare-root plants are fragile and must be kept cool and moist. Plant them as soon as possible.

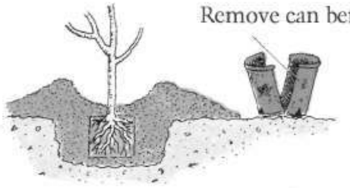
Ball and Burlap Planting

Do not jar the rootball or you may damage the tree. After the first layer of fill is pressed down, lay back the burlap and fill again. Soak, make mound, soak again. Protect all newly planted trees from winds or strong sun.

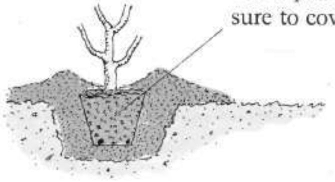


Container Planting

Cans



Fiber pots



Bare-root plants are sometimes put into containers at the nursery. If you buy them in winter or while they're still dormant, you can bare the roots again to plant them. If they have already leafed out, keep them in their containers until May or June so the root system has time to knit the container soil.

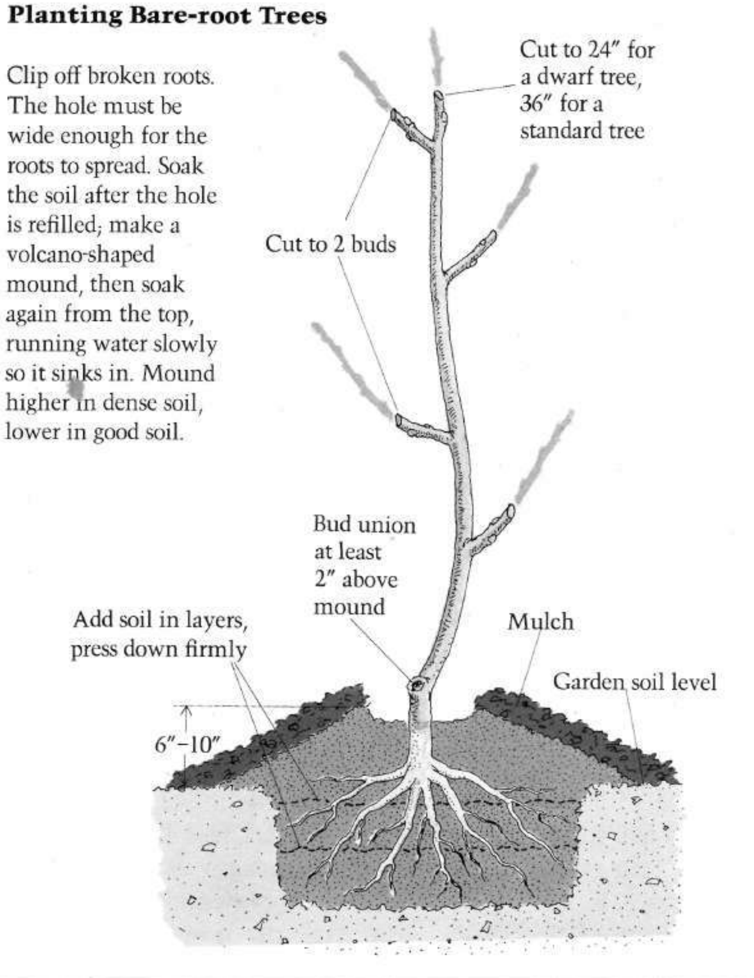
Fruit trees are seldom sold balled and burlapped, but they are frequently sold in containers made of plastic, pulp, or metal. Balled and burlapped plants are sold at the same time as bare-root plants and should go into the ground or their permanent containers quickly Trees sold in containers are available the year around and may be held until time to plant, as long as you don't cut the container.

Never let bare-root or balled and burlapped plants lie around unprotected. If you must keep bare-root plants for a time before you can plant, dig a shallow trench, lay the plants on their sides with the roots in the trench, and cover the roots with moist soil. This is called "heeling in." Wrap balled and burlapped plants in a sheet of plastic so the rootball stays moist.

Planting Trees and Shrubs

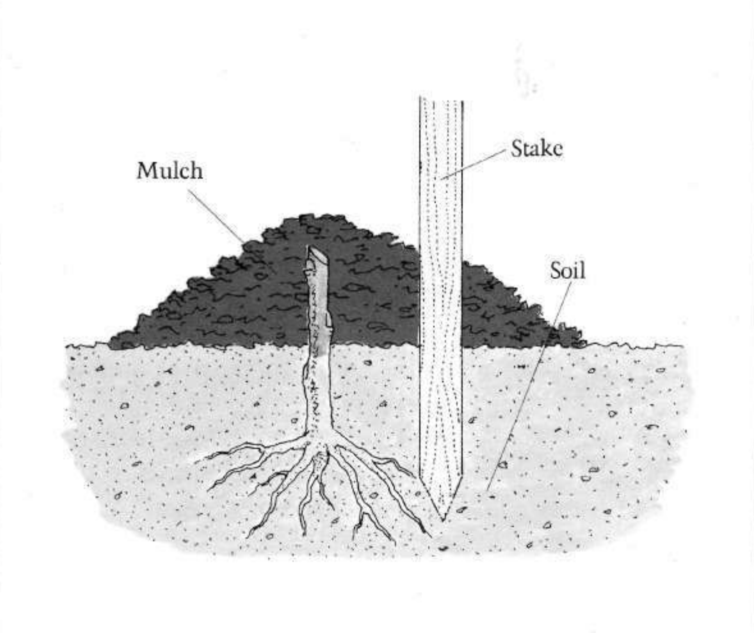
The illustrations here will give you some idea about how to plant a tree from the nursery. Remember never to plant if the soil is very wet. Working wet soil packs it, driving out the air and trapping the roots. In rainy climates you can dig the hole for the plant in the fall and keep the soil mound dry by covering it with a weighted plastic sheet. The soil will then be workable any time.

A good rule of thumb is to dig the planting hole twice the width of the rootball. Another good rule of thumb is always to plant high. Notice in the illustrations that the planting soil is mounded above the normal soil line. The most fragile part of a woody plant is the crown, that section where the roots branch and the soil touches the trunk. The crown



Planting Bare-root Trees

Clip off broken roots. The hole must be wide enough for the roots to spread. Soak the soil after the hole is refilled; make a volcano-shaped mound, then soak again from the top, running water slowly so it sinks in. Mound higher in dense soil, lower in good soil.



Planting Cane Berries and Grapes

Plant a rooted cutting with two or three buds above the soil. Cover these buds with mulch.

must be dry most of the time, especially in spring and fall. Raised planting minimizes crown rot fungus (which can be fatal to the plant) by making it impossible for water to puddle near the trunk. If you plant at soil level, the soil in the planting hole might settle, causing your plants to sink.

Be especially careful when planting grafted dwarf fruit trees. Dwarfing rootstocks may blow over unless they have support and most apples on dwarf rootstocks require staking. Many growers now place the bud of the fruiting variety high on the rootstock, up to 6 or 8 inches above the roots. This bud union shows later as a bulge with a healed scar on one side. It's tempting to plant the tree close to this union for stability, but don't plant the tree deeper than it was at the nursery, or you may have problems with crown rot later.

Be careful not to bury the bud union in soil or mulch at any time during the life of the tree (see illustration, at left). If moist material touches the union, the upper fruiting part will root, and its vigorous root system will produce a full-sized tree instead of the dwarf you bought. Check the bud union frequently for signs of rooting and keep mulches a few inches away from it.

Planting Cane Berries and Grapes

Cane berries and grapes are usually sold bare root in the spring. Plant at the same depth as they were growing before being harvested for sale. There is usually a line on a bare root plant that indicates the previous soil level. Cut back canes to two or three buds. If you are staking the plant, place the stake at planting time to avoid injuring the roots.

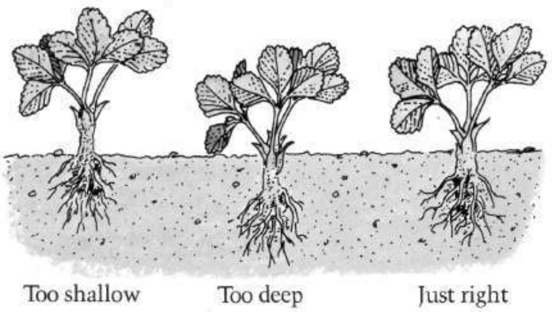
Planting Blueberries, Currants, and Gooseberries

These plants are often sold in containers and should be planted slightly deeper in the ground than they were in the container. For currants and gooseberries, leave only the three strongest branches and cut these back to eight inches. Space plants 3 to 4 feet apart.

Plant blueberries about an inch deeper than they grew in the container. Plants should be spaced about 4 to 6 feet apart. Rabbiteye blueberries grow larger and should be spaced a bit farther apart.

Planting Strawberries

Plant strawberries with the roots spread in a fan shape. Keep the crown above the soil line.



Planting Strawberries

Strawberries are sold either bare root in early spring or planted in flats, six-packs, or 4-inch containers. Plant strawberries with the roots spread in a fan shape. Be sure to plant so that the crown is above the soil line.

Strawberries can be grown in the matted row or double row hill systems. In the matted row system, all runners are allowed to grow which gives larger yields the first bearing season. The plants should be spaced 12 inches apart and rows should be spaced 3 feet apart.

In the double-row hill system, plants are 12 inches apart in the row and rows are 12 inches apart. All runners are picked off. Each double row is raised and separated by a 24-inch trough that allows you to walk among the plants to pick or care for them. The system lends itself to everbearing strawberries or those that don't send out many runners.

FEEDING

Plants "eat" sunlight; what we feed them is actually mineral nutrients. The three primary plant nutrients are nitrogen, phosphorous, and potassium. Plants also need three secondary nutrients—calcium, magnesium, and sulfur—and small quantities of trace nutrients, including iron, manganese, and zinc. Nitrogen in some usable form is the only element that is always in short supply You can add it as ammonium nitrate, ammonium sulphate, calcium nitrate, complete fertilizers, or manure.

Fruits rarely need extra phosphorus, but they will occasionally need potassium and the other nutrients. If growth is slow or leaves and fruit look unnatural or unhealthy, check with your nursery or agricultural extension agent to find out what should be added.

Feeding is less a matter of exact measurement than of how the plant responds. Nitrogen forces leafy growth, but too much growth at the wrong time can harm your fruit crop. In most cases feed the plant less from mid-June through leaf fall. If it produces only a few inches of growth one season, step up feeding. If it sprouts up like a geyser, feed less. Slow growth and pale or yellowish leaves mean that the tree is getting too little nitrogen.

The following are general guidelines for the amount of 10-10-10 fertilizer needed for fruiting plants each year. These three numbers, found on all fertilizer labels, refer to the percentages of nitrogen, phosphorus, and potassium (always in that order) contained within that particular product. If a different analysis fertilizer is used, adjust with respect to the percent nitrogen (that is, double the amount of fertilizer if the analysis is 5-10-10 but don't change the amount if the label reads 10-5-5).

Although one or two feedings are often recommended, we suggest feeding equal amounts of chemical fertilizers four times at evenly spaced intervals between early spring and late June unless otherwise noted. Keep fertilizers away from the trunks of trees and shrubs and water very deeply after feeding.

Fruit and Nut Trees

Use the following schedules for standard-sized fruit trees. Dwarf trees will require proportionately less, and very large nut trees will require more.

First and second season Four tablespoons 10-10-10 fertilizer per year; one at each feeding, scattered evenly

Third to seventh season Double the amount each year: 8 tablespoons or 2 tablespoons per feeding in the third year, 16 tablespoons or 4 tablespoons per feeding in the fourth year, 32 tablespoons or 8 tablespoons per feeding in the fifth year, 64 tablespoons or 16 tablespoons (one cup) per feeding in the sixth year, and 128 tablespoons or two cups per feeding in the seventh year.

Mature tree Continue feeding with 2 cups per feeding, for a total of 8 cups per year.

Grapes

Apply 4 tablespoons 10-10-10 fertilizer per plant per feeding four times a year for a total of one cup per plant per year.

Strawberries

Apply 2 cups 10-10-10 fertilizer per 100 feet of row at the end of June and again in August.

Brambles

Apply 2 cups 10-10-10 fertilizer per 100 feet of row per year.

Blueberries

Apply 2 tablespoons to 1 cup of ammonium sulfate (which makes the soil more acid) per plant, depending on plant vigor and size.

Feeding With Animal Manure

Animal manure improves the soil texture as well as adding nutrients but it is lower in nitrogen than chemical fertilizers, and it may contain salts, which can be harmful in dry climates. Be especially careful of bird, rabbit, and feed-lot manures in dry climates. If leaves show brown edges from salt burn, soak the root area for several hours and change to another feeding method. Well-rotted barn or stable manure is safer.

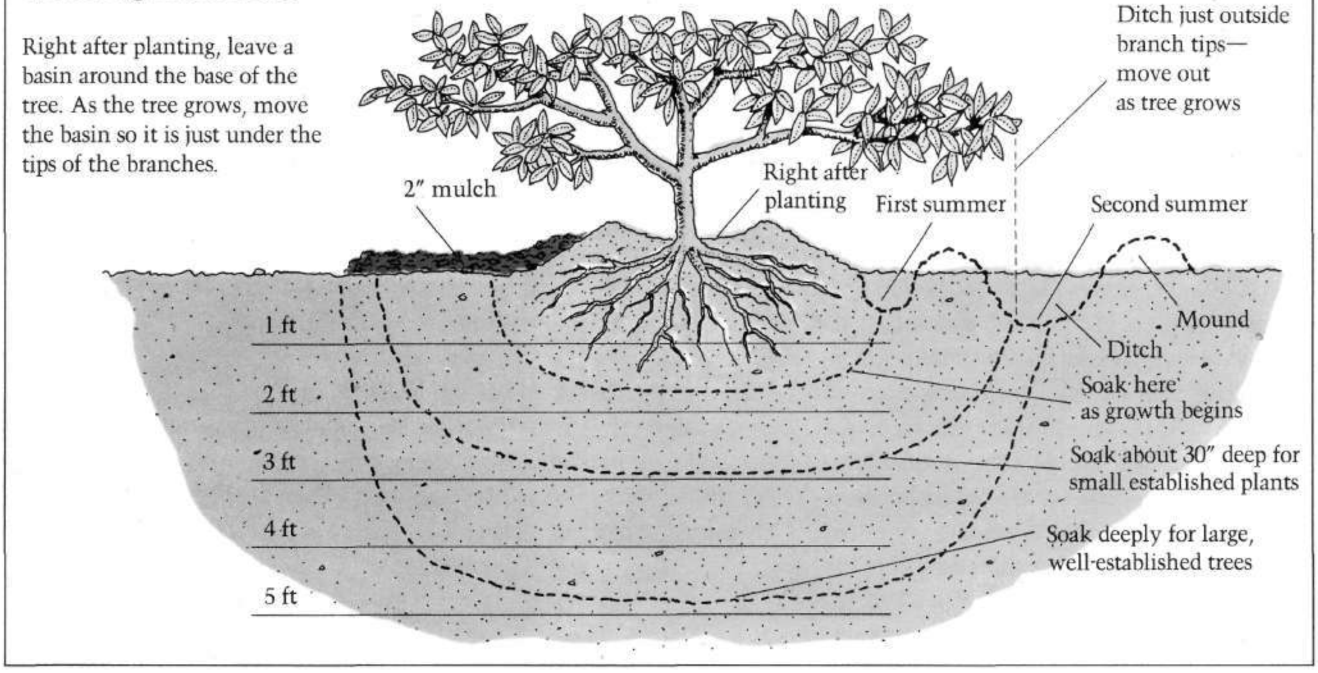
Since manures contain less nitrogen per pound than chemical fertilizers, you can use relatively more, and because they release nitrogen slowly through bacterial action, you can put the whole amount around the tree at one time. For young trees begin with a little less than 1/2 pound of dry bird manure, or about 1 pound of dry cattle manure, and double each year. For mature trees, use 50 to 70 pounds of well-rotted bird or rabbit manure, spreading it under the outer branches in fall. For the same trees, use 100 to 200 pounds of well-rotted cattle manure.

WATERING

Standard fruit trees need a lot of water. If this is not supplied by spring and summer rains, deep watering is necessary Dwarf trees on shallow-rooted stocks may not need as much, but they must have a constant moisture supply At planting time, water each layer of soil in the planting hole. If the garden soil is dry soak the hole itself before you put in the plant. Finish by creating a depression in the planting mound to hold the water, then soaking the tree thoroughly Take care that water does not run out of the depression.

Watering Fruit Trees

Right after planting, leave a basin around the base of the tree. As the tree grows, move the basin so it is just under the tips of the branches.



Do not water again before new growth begins unless the soil seems dry. The roots are not growing actively at this time, and soggy soil will invite rot. When new growth begins, let the top inch of soil dry and then give the plant a thorough soaking. Be sure to water at the top of the planting mound. This is especially important with balled and burlapped plants since the soil in the rootball may not take up water unless it is applied directly overhead.

When first-season growth is abundant and plants are growing well in midsummer, build a shallow basin around the base of the planting mound to direct water to the plant's roots. Water by filling the basin. This basin should be expanded in size each year so that it is just outside the tips of the branches.

Plants that are actively growing generally need 1 inch of water once a week, or about 2 gallons of water per square foot of root spread once a week. (The roots generally spread out somewhat farther than the top canopy of the tree.) A newly planted tree would have a root spread of up to 2 square feet and, therefore, would need 2 to 4 gallons of water a week. Adjustments can be made for rainfall and soil type. Your tree may need water quite often in very sandy soil, less often in heavier soil. Always dig down a few inches into the soil first to see if watering is necessary

Trees in a lawn area should have a deep soaking about twice a summer in addition to normal lawn watering.

FRUIT IN CONTAINERS

Containers make plants mobile. Moving fruit plants to shelter when cold weather comes or to a shady spot if excess heat is the problem, makes it possible to grow them outside their normal climate ranges. With containers you can relocate plants to find out where they do best and even try varieties not usually recommended for your climate, such as peaches in North Dakota. Deciduous trees can survive a winter season in a garage. One caution, however: plants in containers are not as hardy as those in the ground. You must give container plants winter protection in climates where the ground freezes to any depth at all.

What fruits can you plant in containers? Virtually any you like. Trees, of course, must be grafted or genetic dwarfs. The "Encyclopedia of Fruits, Berries & Nuts," beginning on page 59, lists a great many dwarf varieties of apples, apricots, cherries, nectarines, peaches, pears, and plums, all of which are suitable for container culture. Any fig can be grown in a container. Strawberries can be planted in large or small containers, and blueberries and currants make excellent container plants. You can even plant grapes, providing you give them a trellis or other support during the growing season.

Choosing Containers

What kinds of containers are suitable for growing fruit plants? Again, virtually anything you like, as long as it will hold the plant and a sufficient amount of soil, is nontoxic, and contains holes for adequate drainage. Half-barrels, for example, make excellent containers for fruit trees, as do wooden and ceramic planters.

Whatever type of container you choose, the size should be just 2 or 3 inches wider than the roots of your plants. The right size container allows roots easy access to water and nutrients without giving them so much space that root growth occurs at the expense of top growth. If you start with a bare-root apple, a pear, or one of the genetic dwarf fruits, your first container should be about the size of a 5-gallon can. Let the young tree grow for a season and then repot it the following spring in a larger container.

If you plan to relocate the plant and its container, carefully consider container size in advance. The maximum for mobile containers should be about bushel size. Anything bigger will be too bulky to handle or move. Half-barrels, or any boxes or pots that hold about an equal volume of soil, are roughly the right size. The smaller the container, the easier it is to move. However, keep in mind that the plant must have sufficient room for its roots and that more work is involved in feeding, watering, and root pruning with smaller containers. All these factors must be balanced when choosing the best container.

Strawberries are the ideal container plant; they are attractive, tasty, and small enough to be easily moved. Bring them up front when they are flowering and fruiting, then move them to an out-of-sight corner until the following spring.

You can grow what would otherwise be a large tree—such as this fig—in a container, but use a light mix or it will be difficult to move. Substitute perlite for some of the sand in the recipe on this page to make it lighter

Container Soils

Because containerized soil loses moisture easily, the soil must hold moisture well. To prevent soggy roots and the possibility of disease, it must also have good drainage. Commercial mixes, often referred to as soilless mixes or synthetic soils, fit the bill.

Synthetic mixes offer several advantages. They are free of disease organisms, insects, and weed seeds. They are lightweight—half the weight of garden soil when both are wet—which is an advantage both in relocating container plants and in growing them on roofs or balconies. In addition they can be used just as they come from the bag, often without needing to be moistened for planting.

If you plan to fill a number of containers, you may want to save money by mixing your own planting medium. Here is a basic recipe:

- 9 cubic feet of fine sand designated as 30-270 (numbers refer to screen sizes the sand will pass through)
- 9 cubic feet of ground bark
- 5 pounds 5-10-10 fertilizer
- 5 pounds ground limestone
- 1 pound iron sulphate

Some gardeners like to add a little rich loam to the mix of sand and organic material. Add up to one-third loam if you like, but be careful not to include clay soil, which holds too much water for a container mix. Also remember that if you add topsoil to the mix, you may give it good physical properties but you will also increase the risk of introducing soil pests and diseases that can harm your plants.

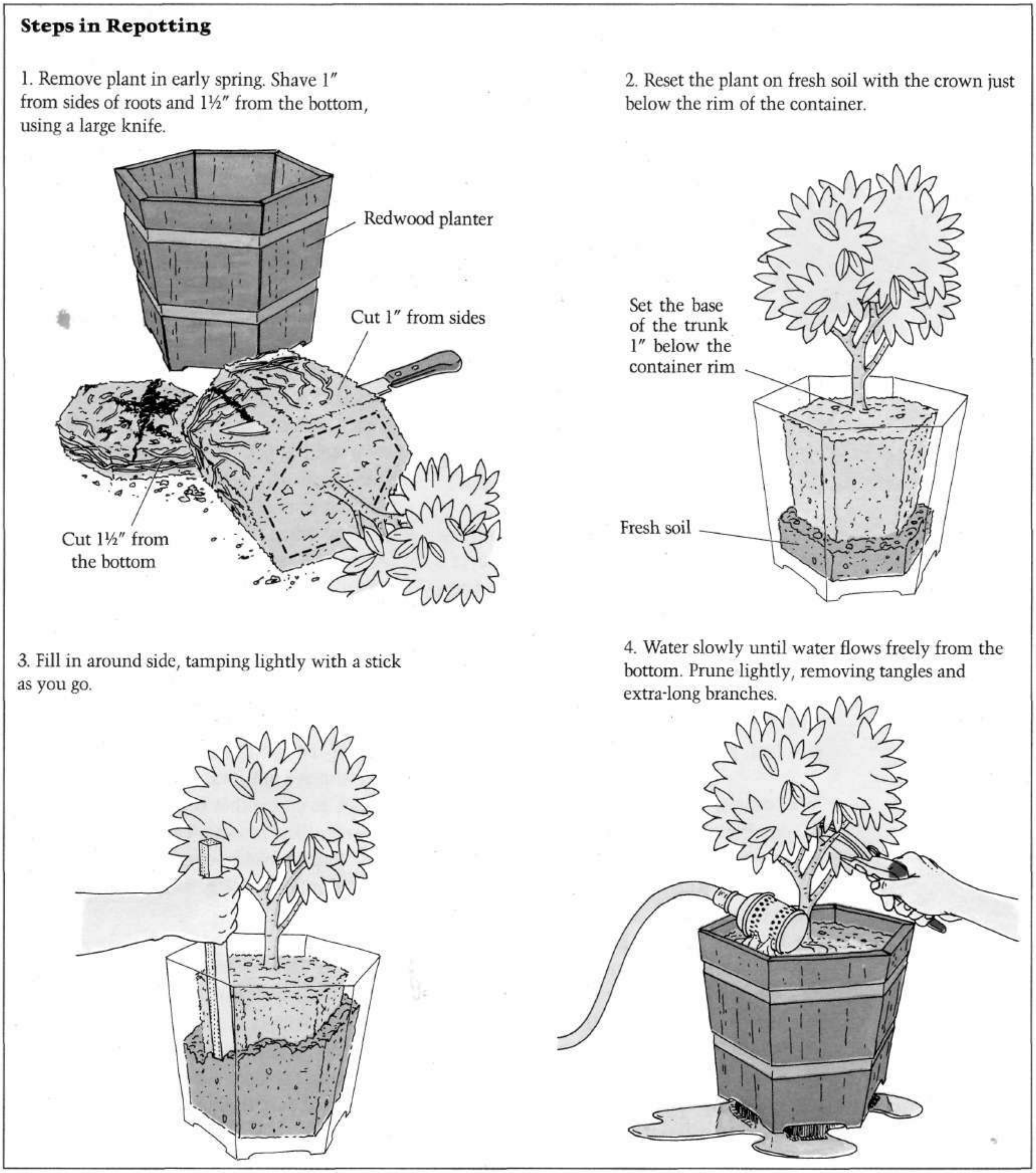
Potting and Repotting

Before you pot your fruit plant, make sure your container has drainage holes. Cover the holes with screen or broken pieces of crockery but don't cover the holes tightly or you'll retard drainage. Do not fill the bottom with rocks or coarse gravel; contrary to popular opinion these do not improve drainage, they simply take up space in the container.

To plant a bare-root plant, place enough tamped-down soil mix in the bottom of the pot so that the plant crown is slightly below the container rim when the roots are touching the mix. Hold the plant at that level and toss in enough mix to support it, tamping lightly as you go, and filling the container to about an inch below the rim. The soil will settle, leaving room to water.

When planting fruits grown in nursery containers, remove the container and scratch the rootball all around with a fork to rough up the roots and direct them outward. Be sure to cut off long roots spiraling at the bottom of the rootball. The plant should be planted just as deep as it was in the nursery container—and no deeper—with at least an inch between the pot rim and the soil level.

Repotting is similar, as shown in the illustrations on the opposite page. Repotting is necessary because plants tend to bunch feeder roots at the wall of a container where they dry out and die more easily This creates shortages of water and nutrients even when you are providing proper care. When you shave off an inch of root and add fresh soil, the plant will grow healthy young roots in the new reservoir of moisture and nutrients. New top growth will soon follow new root growth. After potting or repotting, give the plant a good deep watering.



Feeding Container Fruit Plants

If you are using a purely synthetic mix, you must be careful about feeding. The nutrients you add often wash through the soil when you water, so you'll have to feed more often. It's best to keep to a regular schedule.

One good feeding method is to give each plant about half the recommended quantity of complete fertilizer (one that contains nitrogen, phosphorus, and potassium) every two or three weeks. If the label recommends 1 tablespoon per gallon of water each month, use 1/2 tablespoon per gallon instead and feed every two weeks. A liquid fertilizer is easier to measure in exact proportions and is also less likely to burn roots.

It can be difficult to know when to water hanging plants because you can't see—and sometimes can't feel—the soil surface. Try lifting the container slightly to test its weight. With some practice you will be able to gauge its dryness accurately.

Another good method is to use slow-release fertilizer pellets. These dissolve slowly over a period of time, releasing nutrients with every watering.

Feed from the beginning of the growing season until the end of summer if the plant is to receive winter protection. Stop about mid-July if the plant is to stay outdoors. This will give both a chance to harden new growth.

Watering Container Plants

If you check the soil occasionally by digging down an inch or two, you'll soon learn when to water. Water whenever the soil just under the surface begins to dry Judge when to water by the behavior of your plant. It should never wilt, but it shouldn't stand in soggy soil either. The top inch may stay moist for a week in fairly cool weather, but in hot, windy weather you'll need to water more often, perhaps even every day for a plant that needs repotting. (This is why well-drained soil is important. You can water liberally without drowning the roots.) Water enough with each irrigation so that a good amount drains from the bottom of the container. Don't count on rain to do all of your watering. The foliage of plants in containers can act as an umbrella, shedding most of the rainfall. Check the soil even when rain has been abundant.

Vacation watering When you leave home for a long period, group your containers near a water source and away from the afternoon sun. Grouping them will help keep them moist, shade will further cut the need for water, and if they are located near a hose, your vacation waterer won't miss any of them by accident. For large numbers of containers, you can hook up a permanent system of small hoses and add a timer that turns water on at regular intervals. Drip systems are particularly effective.

Leaching It is important to leach container soil occasionally to remove built-up mineral salts that can burn leaves. Salts accumulate from fertilizers and from hard water. (Any water that won't produce good soapsuds or leaves bathtub rings is hard water and has a high salt content.) You'll know you have a salt problem when you see brown leaf edges. Leaching is running enough water through the soil to wash away the salts.

Every couple of months, leach your soil. Put your garden hose in each container and let it run slowly for about 20 minutes. The water should flow just fast enough that it soaks through the soil and out the drainage holes of the container. It is a good idea to fill the container until water runs freely from the bottom, go on to other containers, then return and repeat the process. This will keep salts to a minimum. Avoid using softened water on your plants because it contains harmful chemicals.

Winter Protection

If you live in a climate where your garden soil freezes in winter, then container soil is likely to freeze all the way through. Gardeners in the coldest northern zones should plan to protect even hardy deciduous plants during the coldest months of the year when these plants are in containers.

The easiest way to protect a container plant from freezing winter temperatures is to move it into an unheated cellar, garage, porch, or room. You can also bury the pot in the ground, making sure to place it deep enough that the soil covers the rim. Heaping sawdust, leaves, or woodchips around the pot will help protect the roots if temperatures do not drop too far below freezing.

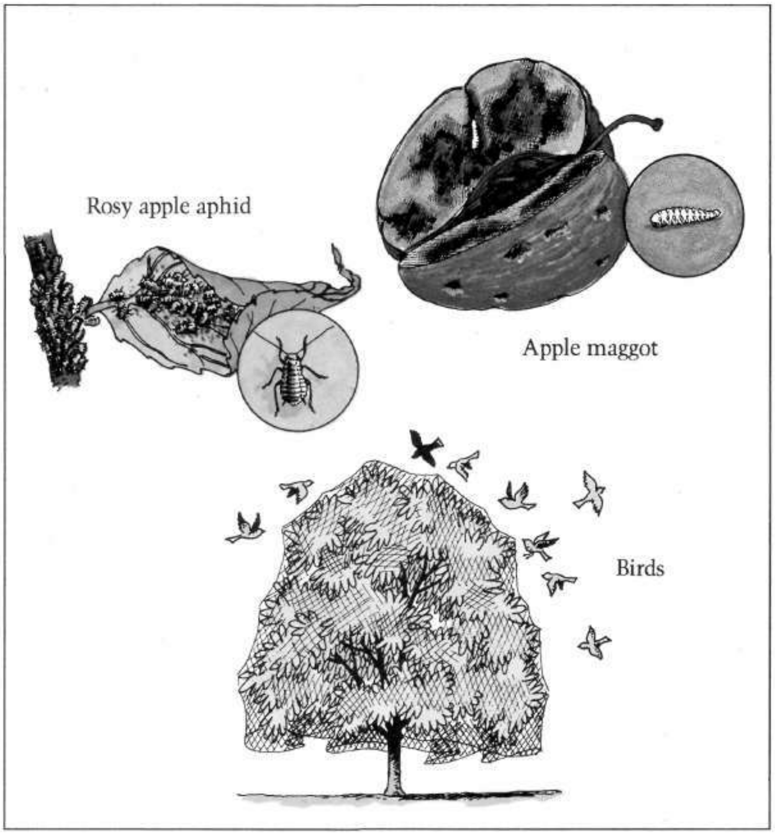
PESTS AND DISEASES OF FRUIT

The more energy your plants expend recovering from the effects of pests and diseases, the less fruit they will bear. Here are some tips on giving them a helping hand that will bring ample rewards at harvest time.

One of the best defenses against pests and disease is a vigorous plant. Healthy fruit and nut trees and berry plants resist infection and can overcome insect attacks, but sickly, weak plants will succumb to these problems.

Sanitation is another good method of disease and insect prevention. Be sure to remove all remaining fruits, berries, and nuts at the end of the season and clean up the ground below the plants. This material can provide a home for overwintering pests; either burn it or seal it in a bag to be discarded. Your neighbors' trees and shrubs may be the source of some of your trouble, but there is no way to make others keep their plants pest-free. Just be sure to prepare the soil properly and keep the tree, shrub, or vine watered and fed. Beyond that you must accept the fact that you may lose some fruit each season: In most cases there will be plenty left for a good harvest.

When you use chemical control measures, read the label carefully and follow all directions exactly



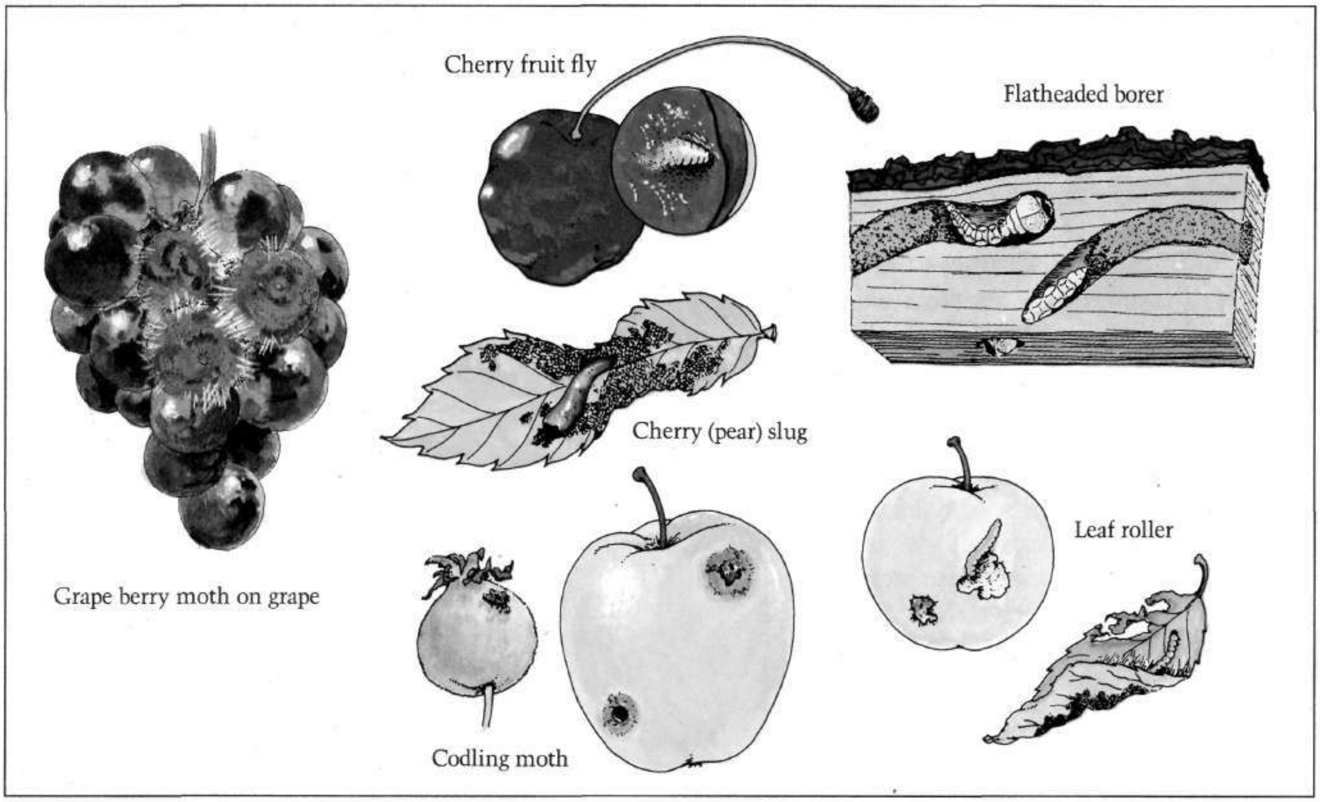
Fruit Pests

The pests listed here are among the most common, although you may encounter others. A few are confined to specific regions of the United States.

Aphids These are soft-bodied insects that damage leaves and fruit by sucking plant sap. A dormant oil spray kills overwintering eggs, and malathion or diazinon contact sprays help control the insects during the growing season if sprayed once a week.

Apple maggots (railroad worms) This pest is found primarily east of the Rockies, but it is also becoming a problem in the Pacific Northwest and northern California. The apple maggot has adult flies that lay eggs under the skin of the fruit. When the eggs hatch the larvae tunnel through the flesh. The flies are active from July through harvest. Keep trees clean and remove damaged fruit. Spray with diazinon or carbaryl (Sevin®) products, following label directions. Do not use diazinon within 14 days of harvest. These pests can also be controlled effectively by hanging "sticky balls"—red spheres coated with auto grease or latex, which traps the insects—in your trees.

Birds The biggest problem with cherries, blueberries, and other small fruits is that birds can remove the entire fruit. When fruit begins to ripen, cover the whole plant with plastic netting, which is available from nurseries and hardware dealers. Throw the net directly over the plant, or build simple wood frames to support netting over dwarfs and bushes. For larger trees, strands of cotton twine will annoy the birds when they try to land and may be sufficient. Throw a ball of twine over the tree repeatedly from different sides. The twine usually rots away over the next winter.



Cherry fruit flies This fruit fly starts as a white larva that burrows through the cherries, leaving a hole. Spray at seven-day intervals with diazinon insecticide. Do not spray diazinon within 14 days of harvest.

Cherry (pear) slugs These small, wet-looking green worms are the larvae of a wasp. They skeletonize leaves, leaving lacy patches. When you notice them (probably in June and again in August) spray with malathion insecticide or a contact spray registered for control of the pest. Follow label directions.

Codling moths The major pest of apples and pears, these moths lay eggs in the blossoms and their larvae tunnel in the fruit leaving holes and droppings (frass). After petals fall spray with diazinon insecticide or malathion and methoxychlor insecticide and continue to spray every two to four weeks as directed.

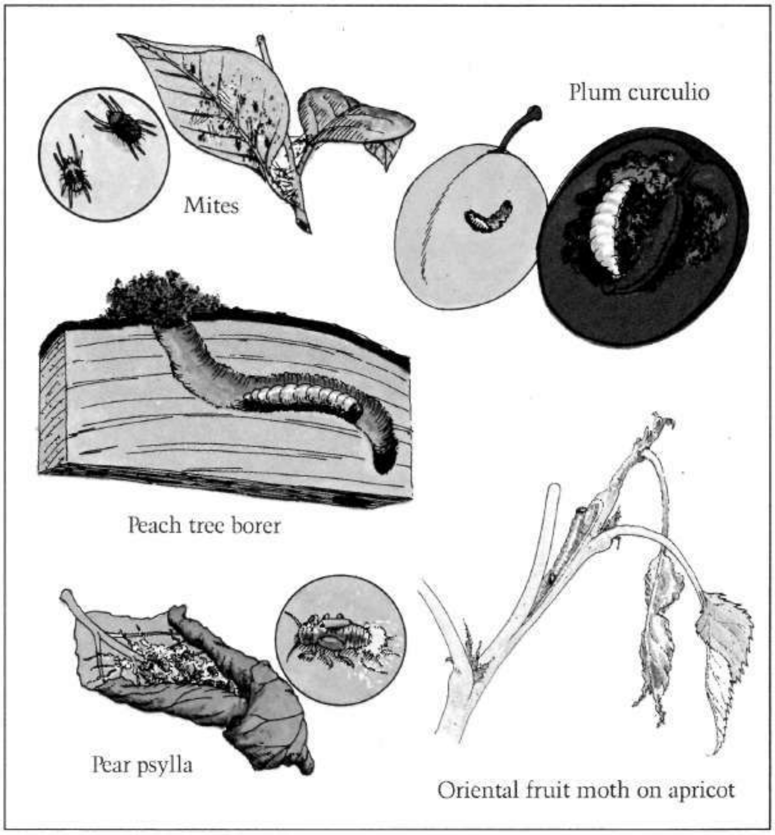
Flatheaded borers This western pest is the larva of a beetle. The borer burrows into bark that has been damaged or sunburned. To avoid the pest, avoid the damage. Paint or wrap young trunks or those exposed by heavy pruning, and be careful not to cut them with tools or machinery When you find tunnels and droppings, cut away bark and wood and dig out the borers, then paint the wound with tree seal or asphalt emulsion. For apples, cherries, and pears, use a lindane product registered for control of this pest.

Grape berry moths This insect damages grapes in the northeastern part of the country. Since the insect overwinters on pieces of grape leaves on the ground, it can be controlled by tilling the leaves into the soil. It can also be controlled with malathion insecticide applied just before bloom, just after bloom, and two months later.

Leaf rollers This moth larva hides in rolled leaves and feeds on both foliage and fruit. Once established it is protected from spray because the spray cannot reach it. Infested leaves must be picked off. Spray with diazinon, carbaryl (Sevin®), or malathion insecticides when pests first appear and continue spray treatments according to the intervals recommended on the label. Leaf rollers can also be eradicated using *Bacillus thuringiensis* (a parasitic bacteria).

Mites Well-watered, vigorous plants are much less susceptible to spider mite infestations than plants subject to drought, dust, and dirt, so keep plants both clean and well-watered. Over-spraying for other insects may trigger a mite attack because spraying kills the mites' enemies. You'll know mites are present if there is a silvery webbing under the leaves, or if the leaves are curled, stippled, or bronzed. Kill overwintering mites with dormant oil spray. During the growing season, use dicofol miticide or other products registered for mite control on fruit trees. In summer oil sprays are safe only for pears.

Oriental fruit moths The larvae of this pest of peaches, plums, nectarines, and apricots burrows into the twigs, which causes the tips to wilt. The most serious damage occurs later in the season when the larvae feed on the fruit. The worms cannot be killed with pesticides alone, but you can control the adult moth by spraying with malathion insecticide and cleaning up infested fruit.



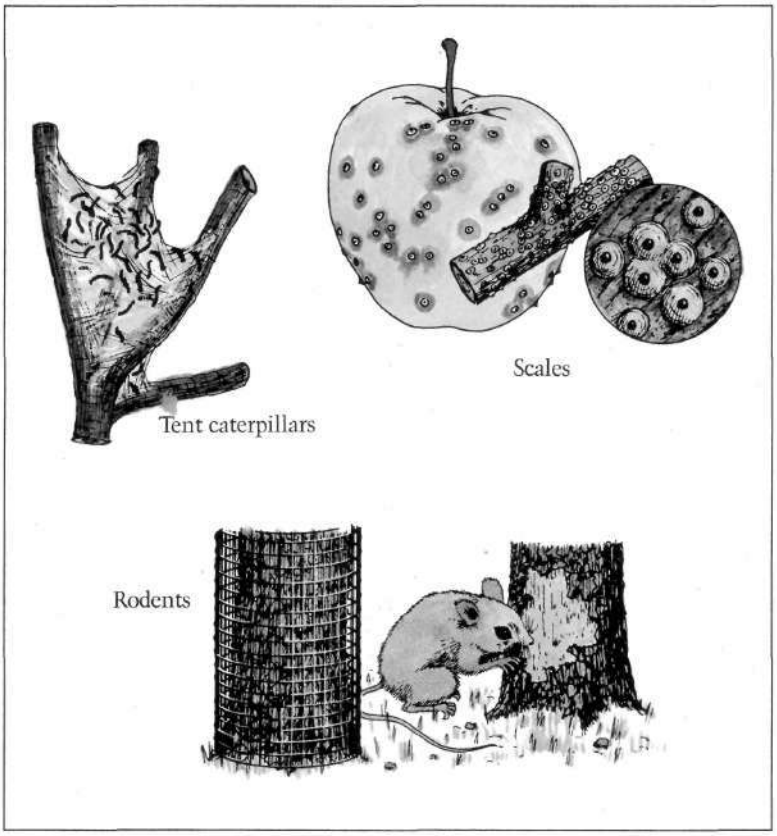
Peach tree borers There are two kinds of peach borer: One bores into twigs and fruit (peach twig and fruit borer); the other, very common borer attacks the trunk at the soil line (trunk borer). To check for the latter, dig soil away from the trunk and check for tunnels and droppings. Kill the worm by pushing a bit of wire down its tunnel. For trunk borer, spray trees with diazinon, carbaryl (Sevin®), or lindane products according to the directions on the label. Check cherry and plum trees for infestations of the same pest.

To control the twig and fruit borer, spray with diazanon insecticide at the following times: in winter, in May, and before harvest (during the safe period indicated on the product label). Trunk borers can also be controlled by placing a ring of mothballs on the ground close to, but not touching the trunk. Mound soil 2 to 3 inches deep over the ring for 6 weeks and then uncover it.

Trees damaged by lawn mowers, frost cracking, or other borers are more susceptible to peach tree borer.

Pear psyllas These insects are related to aphids. Like aphids, the larvae cluster on leaves and suck plant juices, and they excrete a sticky, sweet honeydew that coats the leaves and fruits. A black, sooty fungus may grow on the honeydew, reducing photosynthesis and weakening the tree. Dormant oil spray, applied just before the buds swell, is an effective treatment against pear psylla.

Plum curculios This pest, which belongs to the beetle family, is a serious problem for apples, peaches, cherries, and other wild and cultivated fruits east of the Rockies. Both the adults and larvae damage the fruit. Look for the crescent-shaped scars on fruit made by the female plum curculio when laying eggs. The pests are active for 3 to 4 weeks starting at petal fall. Spray with a malathion and methoxychlor insecticide or other products labeled for control of this pest.



Rodents Mice, voles, and rabbits all eat the bark of young trees, especially when the ground is covered with mulch or snow in winter and better food is unavailable. If enough bark is removed, the tree will die after the first growth surge of spring. Protect the lower trunk in winter or the year around with a cylinder of hardware cloth. Check it occasionally during the growing season and loosen or replace it as necessary

Scales This pest causes spots to develop on infested fruit. Scales appear in masses when infestations are heavy Use a delayed dormant oil spray to control mature scales before crawlers (the immature stage) hatch. Crawlers can be controlled with malathion or diazinon sprays applied in May or June.

Tent caterpillars You probably won't see this pest if you have sprayed early for others. Tent caterpillars build large webs among branches; these webs contain hundreds of hairy caterpillars that emerge to eat leaves. Spray with diazinon or malathion insecticides. Tent caterpillars can also be eradicated by spraying *Bacillus thuringiensis.*

Fruit Diseases

The following are the most common of the many fruit tree diseases. Some are easily controlled with proper sprays (timing is very important); others are best fought by choosing resistant plants, and some require the removal and burning of infected plant parts.

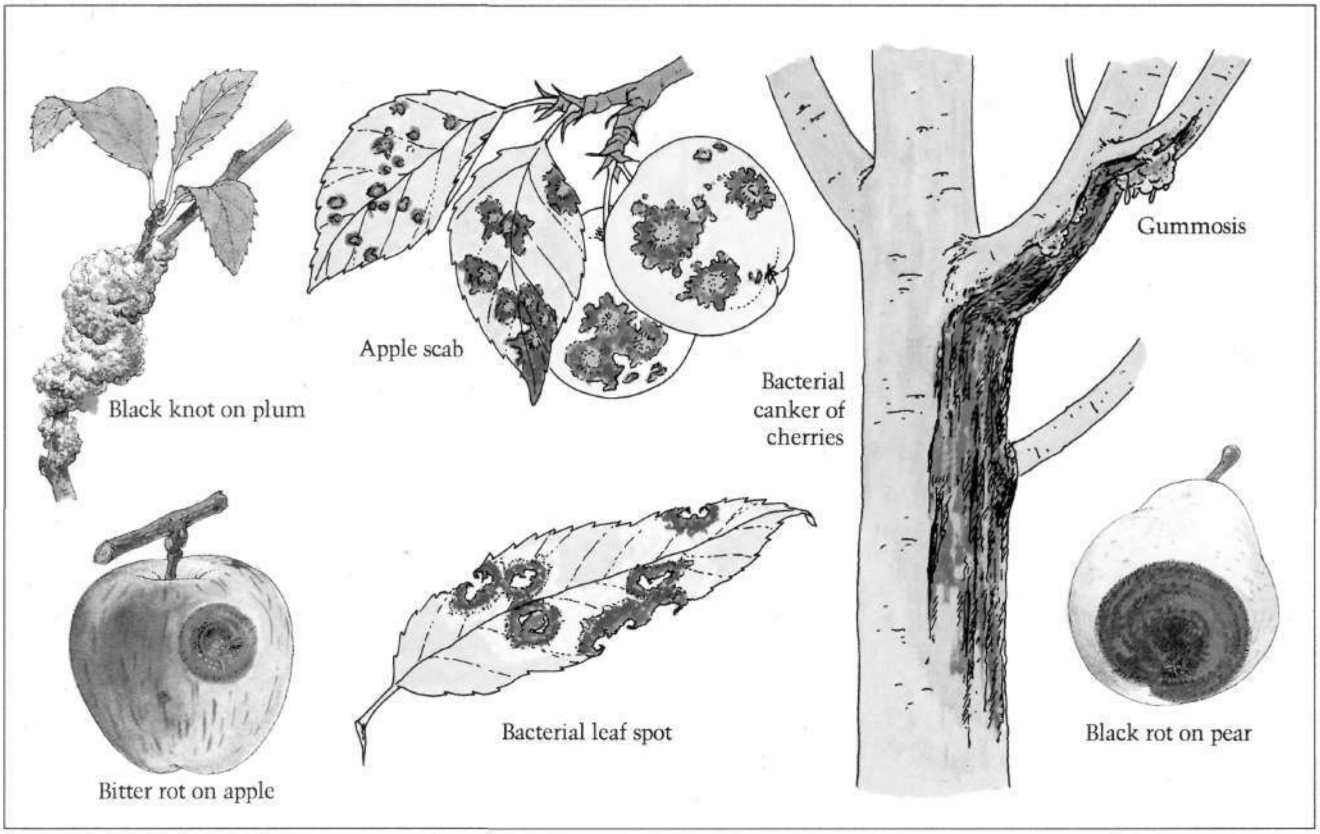
Apple and pear scab These diseases overwinter on apple and pear leaf debris, so be sure to rake up under trees and destroy the material. The fungus infects foliage and fruit. The disease is severest in wet weather and is less of a problem in dry-summer areas. Crabapples also are affected and need spraying. Choose resistant plants when possible.

To control scab, apply captan, dodine, lime sulfur, or benomyl to apples at regular intervals before and after the tree blooms.

Bacterial leaf spot Primarily attacking cherries, peaches, and plums, this bacterial disease lives through winter in leaf debris. In the East and South, the growing of Japanese plums is severely limited due to this problem. The infection, which occurs during rainy periods in the spring, causes brown spots that form in the leaves and develop into widening holes. It may attack fruit spurs and cause fruit drop.

This disease cannot be eliminated, but it can be suppressed by spraying with basic copper sulfate at petal fall or by using streptomycin and terramycin antibiotics later when trees are in bloom and again one month later when rains may occur. For peaches another alternative is to plant only resistant varieties such as 'Redhaven', 'Sunhaven', 'Madison', or 'Loring'.

Bacterial canker of cherries This disease causes long, narrow, damp-looking, gum-edged patches on the trunk or branches. Branches die as they are girdled by these patches. In wet climates avoid 'Bing', 'Lambert', 'Royal Ann', and 'Van' cherries. Resistant varieties are 'Corum' and 'Sam'. The disease can also affect apricots, blueberries, peaches, and prune plums. Do not use susceptible peaches in damp climates.



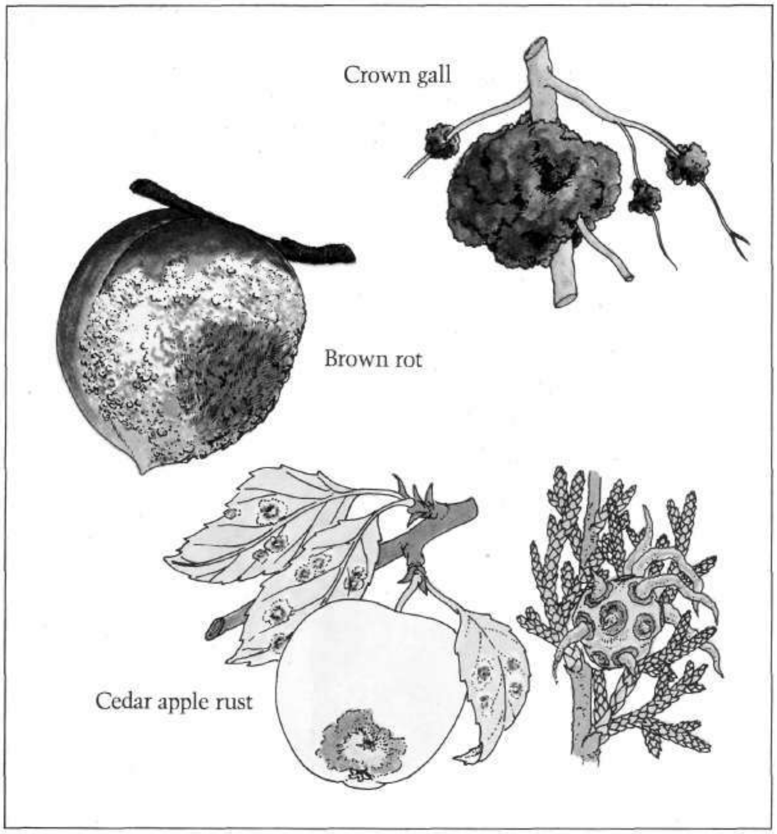
Bitter rot This is the most serious fruit rot of apples in the Southeast. Dark round lesions appear on the fruits and irregular brown spots on the leaves. Remove mummified and newly infected fruit. Captan fungicide sprays will control the disease.

Black knot This disease causes black tar-like swellings on plum branches. The infection can spread from infected wild cherries and plums to cultivated trees, so plant at least 600 feet from any infected trees. Prune out infection. Moderately resistant varieties include 'Methley' and 'Italian Prune'. Resistant varieties are 'Shiro' and 'Santa Rosa'. Some control is possible using a captan or benomyl spray, but spraying alone will not control this disease. Prune out and destroy infected twigs and branches in the fall and winter, making sure to cut at least 4 inches below visible signs of infection.

Black rots There are two major black rot diseases. The first is black rot on apples and is sometimes called frog-eye leaf spot because it causes brown spots surrounded by purple margins on the leaves. It is one of the three fruit rots important on apples in the Southeast. (The others are white rot and bitter rot.) The rotted area is characterized by concentric, alternating black and brown rings. Control by pruning out diseased branches, removing mummified fruit, and applying captan fungicides.

The other black rot is the most serious disease of grapes in the East. Attacking all young, growing parts of the plant, the disease first appears as soft, round, tan spots on the berries. Eventually the berries shrivel to hard, dry mummies resembling raisins.

Plants that dry off quickly are less likely to get black rot, so choose a site in the sun with good air circulation and prune the plants annually Captan fungicide sprays control black rot and are applied when new shoots are 6 to 10 inches long, just before bloom, just after bloom, and then every 10 days until berries reach full size. A moderately resistant variety is 'Delaware'. Except in unusually wet seasons, muscadine varieties are not attacked by black rot.



Brown rot Serious on all stone fruits, but especially on apricots, peaches, and nectarines, this disease, in some regions, makes it nearly impossible for fruit to grow to the edible stage. The disease causes blossoms to brown, turn wet looking, and drop. Brown rot eventually causes fruit rot on the tree. Infected fruit must be removed by hand to prevent reinfection.

To control the blossom-blight phase, spray as the first pink petals show but before the flowers open, using a fungicide such as captan, benomyl, dodine, ferbam, or ziram.

To control attacks on fruit, spray as the fruit begins to ripen (green fruit is rarely attacked) and repeat if there is a period of wet weather. On peaches and nectarines, the disease may attack twigs and overwinter on them. Pruning out dead twigs and removing overwintering fruit "mummies" controls the disease in the following year.

Cedar apple rust This disease appears only where the alternate host, certain species of juniper or red cedar, grows near apples. The apple leaves first show orange spots and odd cup-shaped structures; then they turn yellow and fall. The galls form on the juniper or red cedar plants. Remove junipers and red cedars, or avoid planting them. If you have ornamental cedars, remove the galls in summer. Galls are brownish and globe shaped and look like part of the tree. Spray the apples with a product registered specifically for control of cedar apple rust (ferbam or zineb products), following directions carefully The fungicides in multipurpose sprays usually do not control rust. Select resistant cultivars where cedar apple rust is a big problem.

Crown gall Of bacterial origin, this disease occurs in many soils. It attacks young trees, producing soft, corky galls, or swellings, on the crown and roots. The galls often grow until they girdle and stunt the tree.

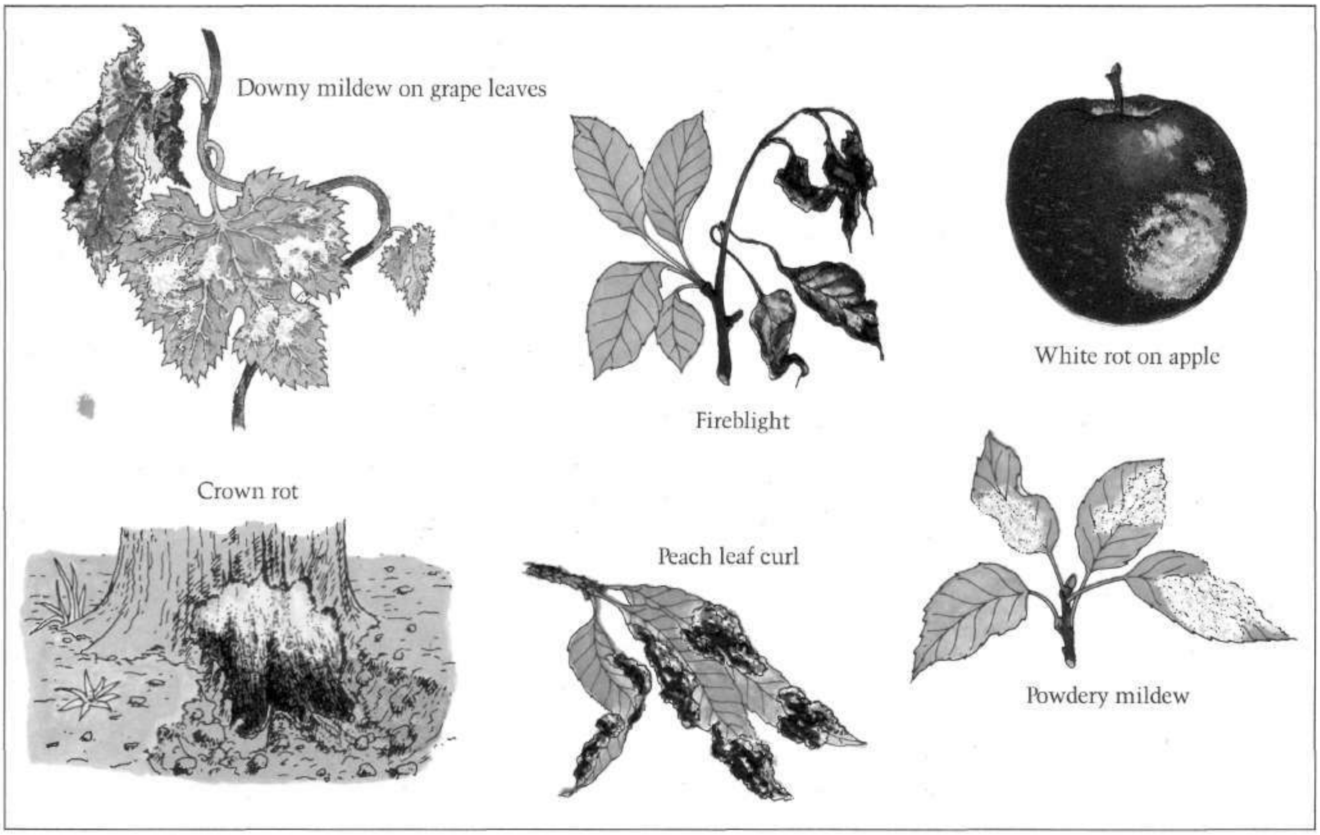
Avoid buying young trees that show galls, and plant young trees carefully to avoid injury as injury allows bacteria to enter the plant. Older trees with galls can be treated with a product called Gallex®.

Recent experimental work has indicated that young plants can be successfully inoculated against the disease.

Crown rot Almost any plant growing in a soil that is frequently or constantly wet may be subject to this serious disease. Crown rot is caused by a fungus. Infected branches redden and foliage yellows or discolors. Look at the bark below the soil line to see whether it is dead; if it is, scrape the bark away and pull back the soil so that air can reach the infection.

Avoid crown rot on established trees by planting high and watering away from the trunk. The soil at the crown should dry as quickly as possible.

Downy mildew Grapes in the Northeast may be attacked by this disease when the weather is cool and moist, first in June and then again toward late summer. A white cottony growth appears, usually on the oldest leaves, but it can also attack young shoots, tendrils, or berries. Control with captan fungicide, and clean up dead leaves where the fungus overwinters.



Fireblight This disease is spread by insects during the bloom period and shows in spring as new growth wilts, turns dark, and finally blackens as if burned.

Only severe pruning and burning of infected wood has proven effective for the home gardener. Choose resistant pears such as 'Lincoln' or 'Magness'. Where the disease is severe, plant resistant apple cultivars such as 'Cortland' or 'Delicious'.

To control infection, cut off any blighted branches several inches below the infection as soon as you notice an attack. Sterilize pruning tools between each cut by dipping them in a 10-percent bleach solution or full-strength rubbing alchohol.

Gummosis Deposits of gum on branches of stone fruits (peaches, nectarines, apricots, plums, and cherries) are fairly common and may be caused by mechanical damage, insect damage, or a number of diseases. Several serious bacterial diseases with this symptom almost rule out the planting of certain fruit varieties in some areas. There is no spray treatment. A disease that often causes gummosis is bacterial canker of cherries, described above.

Peach leaf curl This disease first shows up as a reddening of leaves; leaves then turn pale green or yellow, curl, blister, and may have a powdery look; and finally they fall. A second crop of leaves may grow, which may or may not be affected. No spraying is effective once the disease has appeared.

To control curl you should spray immediately after leaf drop, or just before the buds break, with a fixed copper spray or lime sulfur, wetting every twig and branch completely

Powdery mildew This is a fungus that causes a grayish, powdery coating to form over young shoots, leaves, and flower buds, often deforming or killing them. It thrives in still, shady spots.

When an infection begins, clip off severely mildewed twigs and spray with benomyl. A cold winter will eliminate much of the fungus.

White rot This is an important fruit rot of apples in the Southeast. Papery orange cankers form on branches. Prune out infected branches and spray with captan fungicide.

spray Schedules

To get the kind of unblemished fruit you are used to buying in grocery stores, it is usually necessary to spray fruit trees according to a regular schedule. This chart shows the approximate timing for controls for some of the major problems of fruit trees. See the text for recommended sprays for each problem.

Recommended Spray Schedules

Timing	Apple	Pear
Dormant (Late Winter)	Dormant oil*	Dormant oil* Fireblight
Swollen Bud (all buds closed—no green showing)	Scab Powdery mildew Fireblight	Fireblight
Prebloom (petal color just beginning to show)	Scab Cedar apple rust Black rot Powdery mildew	Scab Leaf roller
Bloom	Fireblight Powdery mildew Scab	Scab—spray at 10-day intervals until rains stop Fireblight
Petal fall	Scab Cedar apple rust Plum curculio Codling moth Fruit rots Aphid Leaf roller	Codling moth Scab Scale Aphid Fireblight Plum curculio Leaf roller
7 days after petal fall	Scab Rust Plum curculio Codling moth Fruit rots Aphid	Codling moth Mites Scab Scale Fireblight Fruit rots
14 days after previous spray	Scab Plum curculio Codling moth Fruit rots Aphid	Codling moth Mites Scab Fireblight Fruit rots
14 days after previous spray	Aphids Plum curculio Codling moth Fruit rots Apple maggot	Pear psylla Codling moth Mites Fireblight Fruit rots
Thereafter: every 14 days until 2 to 4 weeks before harvest, according to label directions of material used.	Scab Plum curculio Codling moth Fruit rots Apple maggots	Pear psylla Codling moth Mites Fruit rots
After leaf fall		

*Do not spray if temperatures are expected to drop below 32° F within 24 hours.

Not all of these problems will occur where you live, and they will probably not take as many sprays as shown. For example, apple maggots don't occur in much of the country, and fireblight can be a problem all summer in humid areas, but is only a spring disease in dry-summer regions.

Apricot, Peach, Nectarine	**Plum**	**Cherry**
Dormant oil* Peach leaf curl	Dormant oil* Peach twig borer	Dormant oil* Gummosis
Peach twig borer	Black knot	
Brown rot Leaf roller Bud moth	Brown rot Leaf roller Black knot Bud moth	Brown rot Leaf roller Bud moth Aphid
Brown rot Powdery mildew	Brown rot Powdery mildew Black knot	Brown rot Powdery mildew
Brown rot Plum curculio Leaf roller Scales Oriental fruit moth Peach twig borer Powdery mildew	Brown rot Plum curculio Leaf roller Black knot	Brown rot Plum curculio Leaf roller Aphid Scales
Brown rot Plum curculio Mites Oriental fruit moth Peach twig borer Scales	Brown rot Plum curculio Scales Peach twig borer Mites Codling moth Aphid Black knot	Brown rot Plum curculio
Brown rot Plum curculio Oriental fruit moth Mites Peach twig borer	Brown rot Plum curculio Codling moth Mites Black knot	Brown rot Plum curculio Powdery mildew
Plum curculio Oriental fruit moth Mites	Plum curculio Mites Black knot	Powdery mildew Cherry fruit fly
Plum curculio Mites Peach tree borer	Plum curculio Mites Black knot	Gummosis Mites Powdery mildew
Peach leaf curl		

Pruning Roses

Roses are among the most beautiful flowering plants. Keeping roses looking lovely and healthy requires regular attention. This means attention to details such as food and water, pest and disease control, training and pruning.

Proper pruning of roses keeps plants healthy and productive, providing a continuous supply of blooms. Pruning roses is simple and easy, even for beginners. Following the guidelines presented here can result in bushes full of beautiful blooms. Detailed information on roses is available in the HPBook, *Roses: How To Select, Grow and Enjoy*.

Proper tools make pruning roses easy and enjoyable. A pair of sharp pruning shears is the most important tool you'll need. Ragged cuts made by dull tools injure rose plants and can create problems with diseases. Loppers and a small saw are useful if bushes are large. Gloves protect hands and arms from thorns.

Careful pruning of rosebushes produces beautiful blooms to brighten gardens with islands of color.

BASIC PRINCIPLES

There are many kinds of roses. Special pruning methods have evolved for each kind. Use the following basic principles to keep your roses healthy and beautiful.

- Encourage new growth at the expense of old. After some roses are several years old, new basal growth virtually stops. New canes are produced high on a few older canes instead of arising from below ground. Prune away old canes just beyond where new canes start.
- Remove dead canes to the crown. Dead canes are brown and shriveled inside and out. Removing dead canes is the first step in pruning any rose. Use a saw if necessary.
- Renmove portions of frost-damaged canes after buds begin to swell. Winter-damaged wood can be determined by cutting through a cane. Healthy wood is white all the way through. Any brown discoloration indicates frost damage. Frost-damaged portions of canes should be removed.
- Remove all weak, thin, spindly growth that crowds the bush's center. Spread branches out, opening the center. Remove crowding stems and twigs back to their point of origin. Leave no stubs.
- Where two branches cross, remove the one *below* the crossing point to prevent rubbing.
- Remove any suckers. Roses are *budded,* a form of grafting, onto a wild-rose rootstock. Suckers are extra-vigorous shoots that grow from rootstock below bud unions. Continued growth of suckers weakens preferred rose varieties.

Crossed canes that touch and rub together on rosebushes can create open wounds on canes. The lower cane should be removed by careful pruning.

Suckers are easy to identify. Suckers have a different color and character, with distinctly different leaves.

Suckers should be removed completely, not just clipped off where they emerge from soil. Remove soil from roots until you can see where the sucker is connected to the rootstock. Hold the sucker close to the trunk and pull downward to break the sucker off. Young suckers pull away easily. Removing suckers removes adjacent buds too. This does not damage the plant. If suckers are clipped off above the soil, they sprout and grow another rose bush in the middle of the existing one.

Suckers occasionally appear on the tall trunk-stem of tree roses instead of underground. Remove these suckers by close pruning.

- Always cut at an angle about 1/4 inch above an outward-facing bud. There is a bud at every leaf. The angle of the cut should slope away from the bud. A cut made at this point heals rapidly and water will drain away from the bud. Stubs will not develop if you cut close to a bud. Stubs are a point of entry for disease.

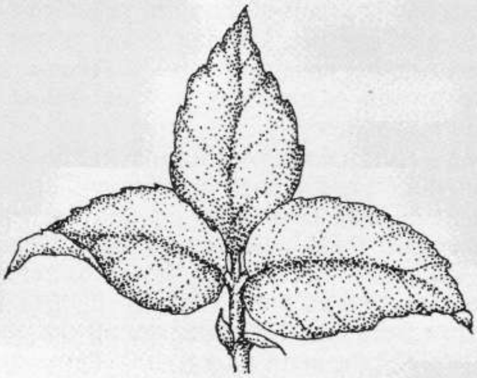
If diseases such as black spot are persistent problems, dispose of all prunings. Never leave prunings in the rose bed or in compost. Sterilize pruning tools with alcohol after each cut.

Pruning cuts on rose canes should be made at a 45° angle about 1/4 inch above an outward-facing bud. Angle of cut should slope away from the bud.

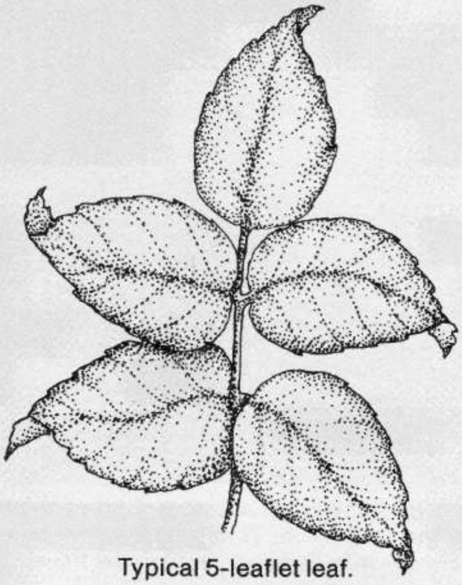
ROSE LEAF TYPES

The flowering rose stem has several leaf types. Recognition of these leaf types and knowledge of general position on the stem is necessary for successful summer pruning. The illustrations on this page show the differences.

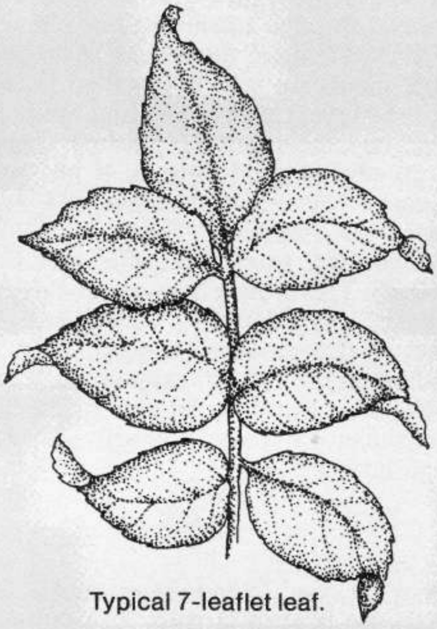
Start from the bottom of a flowering stem. Move up the stem to the first leaf. This is a *3-leaflet leaf.* Typically there is one 3-leaflet leaf. Next are two or more *5-leaflet leaves.* In the stem's middle portion are one or more *7-leaflet leaves.* Two or more *5-leaflet leaves* are above the 7-leaflet leaves. Below the flower, one or two 3-leaflet leaves can be found. On many rose stems there is a straplike simple leaf above the last 3-leaflet leaf.



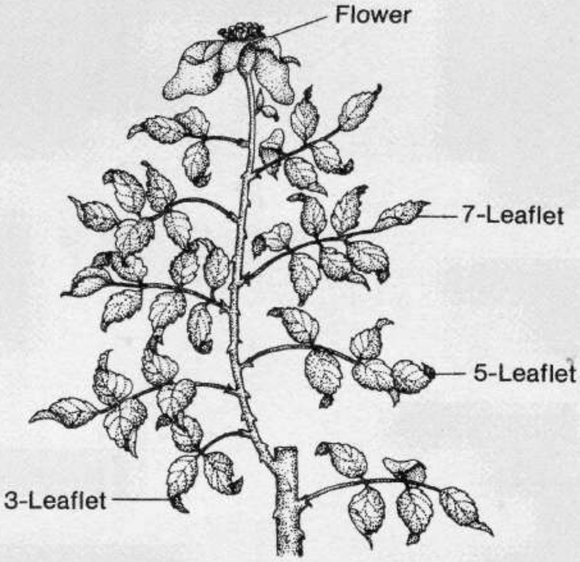
Typical 3-leaflet leaf.



Typical 5-leaflet leaf.



Typical 7-leaflet leaf.



Flowering stem.

Disbudding is the removal of secondary flowering buds from a flowering rose stem. This process concentrates the plant's energy into development of one flower. This flower will be larger and stronger.

Knuckle Cuts—Knuckle cuts are used by commercial growers of rose flowers. Knuckle cutting obtains the maximum number of high-quality flowers from vigorous plants. A commercial grower cuts rose flowers immediately above the second 5-leaflet leaf, point A in the illustration below left. If a bush is getting tall or later growth is weak, the grower makes a knuckle cut. The knuckle cut is made below where the previous cut was made, at point C.

Dead Heading—This refers to removal of flowers that die on the plant. Dead flowers are cut above the highest 5-leaflet leaf if the stem is vigorous. Dead heading allows leaves to remain and continue producing energy for subsequent growth. Weak growth should be removed back to the second 5-leaflet leaf on new shoots or to the older stem.

Stop removing faded flowers in late summer. This allows seeds and the fruit of the rose, called *rose hips,* to develop and mature. Leaving faded flowers on canes in late summer ensures that no late-season, cold-susceptible growth is encouraged. This makes rose plants more winter-hardy.

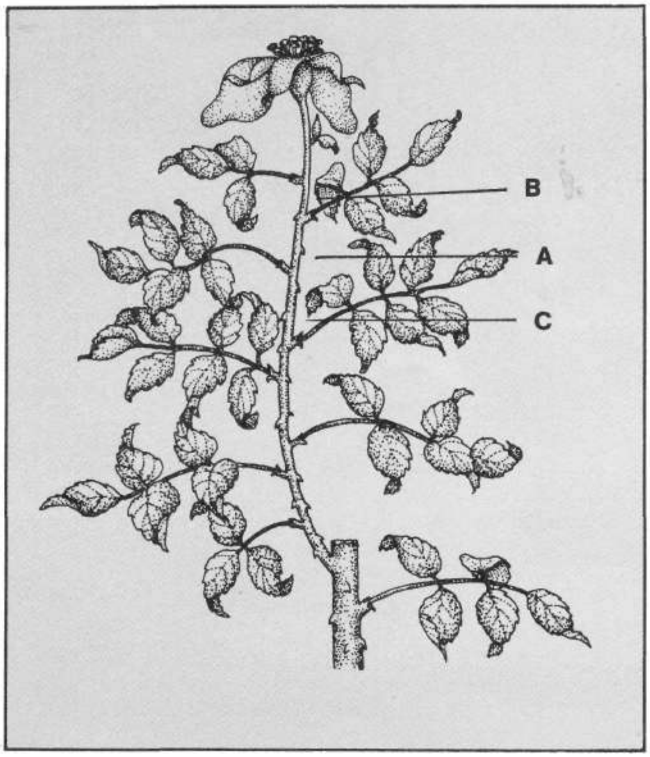
Disbudding—This is done with thumb and forefinger. Disbudding directs new growth in spring and promotes development of large flowers throughout the season. As growth begins, some buds grow strongly toward the center of the plant. These buds should be removed with fingers as soon as growth begins. If three buds begin to grow from one leaf node, rub off the weaker side buds to direct the plant's energy into development of the main bud.

Roses that set flower buds in clusters are often disbudded. Removing side buds concentrates the plant's growing energy into the central flower. This causes the flower to become larger. Pinch lateral flower buds away as soon as possible.

Candelabra Canes—These are vigorous new shoots that usually appear after the first wave of blooms. These canes end in huge candelabras or branches of buds. Pinch the tips of these shoots when 6 inches tall.

These large shoots are usually less than 1/2 inch in diameter at their base. Candelabra canes are ordinary, but extra-vigorous, basal canes. If pinched, candelabra canes produce several good flowers. If not pinched, candelabra canes become unattractive and may die back if pruned when dormant.

Growth originating from a 3-leaflet bud is often weak and spindly. This growth has poor-quality flowers or no flower at all. Growth from a 7-leaflet bud is often vigorous, but it also produces a small, poor-quality flower on a large stem. In both cases stems should be pinched above a pair of 5-leaflet leaves. Pinching at this point encourages vigorous productive growth and produces high-quality flowers.



When growth is not vigorous and height is not a problem, remove faded rose flowers at point B. A cut made at point C, is called a *knuckle cut.* Knuckle cuts should be made if growth is weak or if a bush is too tall. If growth is vigorous and overall height is not excessive, remove faded rose flowers at point A, just above the second 5-leaflet leaf from the top.

Pruning New Roses

Bare-root roses from the nursery have tops shortened. In most cases additional pruning is still needed. Remove weak twigs and shorten main canes. Cut away all broken or dried roots and shorten long roots until they fit into the planting hole without bending.

Do not cut long-stem flowers from new rose plants. Cutting long stems removes food-manufacturing leaves needed by young plants.

Pruning Old Roses

Roses require annual pruning. Prune mature roses late in the dormant season. Mild-climate gardeners begin pruning in December or January. Gardeners in cold regions normally wait until March or April, just before new growth starts. Some rose species tend to die back if pruned one or two months before spring growth starts. Many varieties do tolerate midwinter pruning. If roses are pruned just before new growth starts, wounds heal quicker.

Another important reason to prune late in the dormant season has to do with winter hardiness. The earlier you prune, the earlier new growth begins. Early pruning promotes growth that might be damaged by a late frost. Conversely, pruning late in spring after growth begins wastes plant energy.

Vigorous rose plants, such as climbing hybrid teas, have several periods of rapid growth, called *flushes*, during the season. These roses bloom over a long season. They may tolerate cutting back two or three times if growing conditions are favorable. Frequent pruning encourages good blooming and maintains proper plant shape.

A few rose varieties bloom only once a year, usually in spring. Prune these roses after flowers fade to ensure growth of new wood for next spring's flowers.

Pick off faded flowers and shorten new growth after each crop of bloom. Cut back to strong side buds or laterals. The uppermost buds will form new shoots. In hybrid-tea roses and some everblooming roses, these new shoots eventually flower. After the second crop of flowers has bloomed, growth may be shortened again. This pruning system can produce three or four crops of flowers each season if conditions are favorable.

How Much To Prune—People who grow roses either professionally or as a hobby frequently differ about how hard or far back to prune roses. If winter damage has been extensive, it may be necessary to prune roses to within a foot of the soil. In general, weak-growing varieties can be pruned harder than strong-growing varieties. Hard pruning is usually practiced to produce fewer, more perfect roses. Light pruning allows a bush to grow to its natural size and shape. Lightly pruned roses produce more flowers. These flowers are slightly smaller than flowers from heavily pruned plants.

The following definitions can be used as guidelines in pruning hybrid teas and grandifloras:

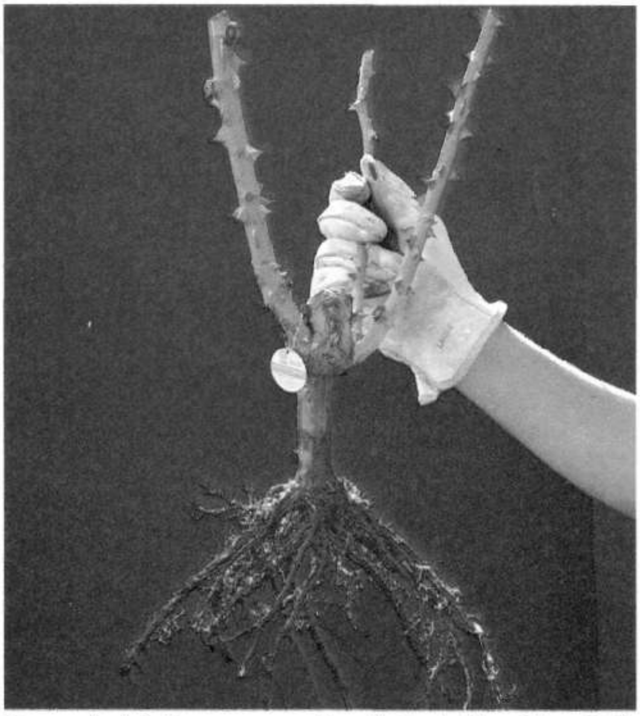
Hard—Thin out all but three to five canes. Prune these canes back to leave two or three *eyes* or buds on each shoot.

Moderately Hard—Thin out all but three to five canes. Cut canes back to five to ten eyes.

Medium—Thin out all but four to seven canes. Cut canes back about 1/2 their length.

Light—Thin out all but four to seven canes. Remove cane tips.

As a general guide, remove about 1/3 to 1/2 of last year's growth. For most hybrid teas, this is five to ten eyes per cane. Remaining canes should be the thickness of a pencil.



Young hybrid-tea roses should look like this. Both canes and roots are shortened before planting.

After bloom is over, pick faded flowers and shorten new growth. Cut back to strong side buds or laterals.

PRUNING DORMANT ROSES

The best time to prune roses is during the dormant season. Begin by removing all dead, twiggy growth. Remove spindly stems that crowd the center of the bush. In general, all growth less than 1/4 inch in diameter should be removed.

Next, remove old canes at bud unions. Select canes or main stems to form the bush framework. Rose canes are old after three or four years. Old canes are grayish and have creases in the bark. New canes are a rich, reddish brown. New canes have smooth bark and brownish thorns.

Select healthy new canes to create a symmetrical plant. Use heavy loppers or a small pruning saw to remove old canes. Never leave a stump or stub. Cut canes flush with bud unions.

Shorten last season's growth by 1/3 to 1/2. Avoid cutting into old wood. Old wood is more susceptible to dieback. Thin smaller branches at the plant's top and center. Remove crossing branches and any suckers growing from rootstock.

Pruning directs growth. Roses should be directed to form an open-center, vase-shape plant. This means cutting to a bud that points up and away from the crown or center of the bush. However, some roses may tend to sprawl too widely. In such cases, prune to an inward-facing bud, directing growth in a more appropriate direction.

Prune dormant roses by removing dead, weak, twiggy growth and old canes.

Shorten last season's growth by 1/3 to 1/2. Avoid cutting into old wood because it is susceptible to dieback.

Don't leave stubs when removing canes. Cut canes flush with bud union.

Remove all other growth less than 1/4 inch in diameter. Remove stems that crowd the center of the bush.

Wound-sealers are essential for roses. Pruned rose canes can lose substantial amounts of moisture quickly, especially when days are warm. Fresh-cut canes are favorite entry sites for boring insects. Use a non-toxic sealer to coat wounds. The sealer prevents drying and protects wounds from insects and disease.

Remove all leaves from bushes in the fall. Leaves must be removed to induce full dormancy before winter. If leaves do not fall in mild-winter areas, cut them off.

Dispose of all fallen leaves, twigs and pruned stems. All these can be reservoirs of last year's disease and pest problems.

Renovating Roses

Older roses that have been untended for some time may need extensive renovation to recover their beauty and health. Older plants are quite tolerant of renovation. Most roses can be cut to the ground and recover beautifully if watered and fertilized.

The recommended renovation process is a little gentler. At the time of winter pruning, remove all canes except the youngest three or four canes. Use a saw and remove canes down to the base. Don't leave stumps. Remove all weak twigs and cover large cuts with pruning sealer.

Prune crossing canes, removing the lower one. Rootstock suckers should be removed by pulling them off.

Shorten remaining canes to balance the rose plant. Wound-sealers should be applied to all pruning cuts.

These older rosebushes have not been pruned for some time. They are in need of severe pruning and renovation to restore their former beauty.

This exhibition-quality rose is named 'Honor'. It was judged the top 1980 All-America selection by the American Rose Society. Exhibition roses are judged on form, substance, color, size, stem and foliage, and balance and proportion.

Summer Pruning

Rosebushes are pruned during summer to increase vigor and produce high-quality flowers. Pruning is just as important during the growing season as during the dormant season. Summer pruning removes flowers for indoor bouquets and prevents seed formation.

Roses that produce seeds do not produce many flowers. Summer pruning also removes weak growth to increase plant vigor. Summer pruning of roses results in better flowers on new growth.

Exhibition Pruning

Exhibition pruning produces high-quality flowers by a specific date. Pruning basics are the same, but plant energy is concentrated into fewer flowers. Plants are pruned hard in winter and disbudded in summer. Experts rub off all but about four buds per cane.

Timing is critical. If pruning or disbudding is done too early, flowering peaks before show time. Prune too late and there won't be enough blooms to select for shows. The time between pruning and flowering varies according to climate. It usually takes about one and one-half to two months. Ask experienced exhibitors in your area about the best time to prune. Prune your bushes a few at a time, beginning one week before the best date. Continue pruning up to one week after the best date.

This table of beautiful roses displays winners at the Portland Rose Society spring show. Roses are arranged by class and color.

PRUNING HYBRID TEAS AND GRANDIFLORAS

These roses produce flowers on current-season's growth. Rosebushes need moderate to heavy annual pruning to produce strong flowering canes. Prune to maintain three to six strong, healthy young canes and vigorous basal growth. Newer plants and plants of low vigor may not be able to maintain six canes. Canes should be uniformly spaced, ideally forming a vase shape.

Prune according to your purpose. Prune heavily for single long-stemmed flowers. Prune lightly for landscape display. Heavily pruned bushes produce fewer, larger flowers. Less-vigorous varieties are pruned lower. Prune these varieties to about 18 inches high and leave two or three dormant buds. Vigorous varieties are pruned to about 2 feet high. Two to four buds are left on each cane. Excessive heavy pruning of some vigorous varieties of roses encourages strong, but flowerless shoots.

Remove old, non-producing canes at the bud union. Prune overlapping interior growth to allow light penetration and good air circulation.

Remove unnecessary new shoots while still small. Remaining new shoots should be lightly pinched when about 1 foot high. Pinching encourages development of laterals. Heading back new tall shoots at regular dormant pruning time may kill the entire cane.

'Peace', hybrid tea.

PRUNING FLORIBUNDAS AND POLYANTHAS

Floribundas and polyanthas are vigorous plants. Both plants produce a continuous succession of large flower clusters. Flowers are smaller and less ideally formed than hybrid tea flowers. Polyanthas and floribundas are usually grown more for landscape display than for individual long-stemmed flowers.

When cutting flowers, remove the entire *cluster* or group of flowers. Cut back to the first outward-pointing bud.

Winter-prune to retain flower-bearing laterals. Shorten them 1/4 to 1/3. Cut crowded, twiggy clusters back to a strong cane bud. Low-growing floribundas tend to produce twiggy interior growth that should be removed. Keep six to eight canes. Keep plants open, with plenty of room to develop new flower clusters.

Light pruning allows early flowering. Heavy pruning encourages new basal growth and late flowering. Prune roses harder or lighter from season to season. Pruning in this manner will balance plant response according to what the plant needs and your desires.

'Simplicity', floribunda rose.

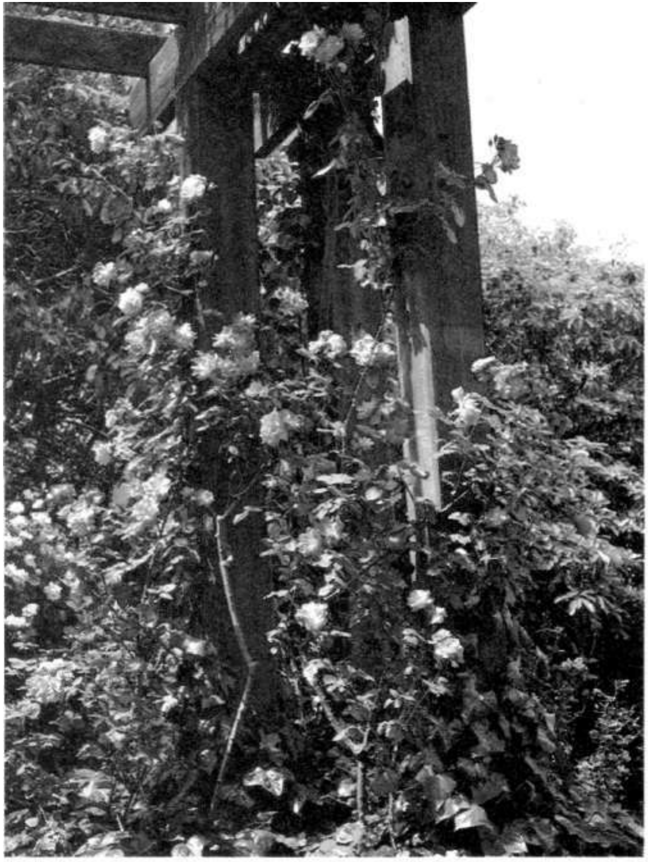
PRUNING MINIATURE AND PATIO ROSES

Pruning needs vary with the plant. Some micro-mini roses need no pruning. Some macro rose varieties need severe pruning in spring and touch-up trimming throughout the season.

To prune miniatures, cut at a 45° angle just above outward-facing buds. Open the plant's center by reducing the number of twigs. Covering pruning wounds with a sealer is not important because the wounds are small. But thick stems may require sealing.

Sometimes strong shoots appear and rapidly grow past all other shoots. Remove these shoots for balanced growth.

'Puppy Love', miniature rose.


'Joseph's Coat', large-flowering climber.

PRUNING CLIMBING SPORTS

Allow repeat-blooming climbing sports to become established during the first few years. Let these roses grow to the height you desire. Don't prune too hard at planting time or climbing sport roses may revert to a bush form. After initial pruning, bend canes and tie them to a fence or trellis. Flowering shoots grow from these bent canes. The same canes produce flowering shoots for many years. Each time you prune, shorten flowering shoots or laterals to 3 to 6 inches long. Prompt removal of faded flowers hastens repeat bloom.

Climbing sports do not produce vigorous basal growth as easily as bush roses. New replacement growth originates high on existing main stems. To encourage new basal growth, cut back the oldest canes to where a new stem develops.

To obtain the largest-possible flowers from hybrid-tea climbing sports, remove all lateral growth from the previous year. A series of long stems grow from horizontally trained-canes. Each stem bears a magnificent bloom. Climbing sports of floribundas bear on many cluster-type laterals. Keep these laterals, but shorten them by 1/3.

Pillar roses are similar to climbing sports. Pillar roses are stiff and upright. These roses usually grow 8 to 10 feet high and are ideal for training vertically against pillars.

PRUNING LARGE-FLOWERED CLIMBERS

Flowers develop on short, 6- to 12-inch laterals. The laterals grow from 2- and 3-year-old canes.

Prune laterals in spring just before buds break. Shorten laterals to 3 to 6 inches or three or four buds. In summer, remove faded flowers to prevent seed pro-

'Blue Moon', hybrid tea.

'Centifolia' moss rose.

Climbing sports flower best when trained on horizontal supports such as this fence.

duction. Summer pruning promotes blooms from repeat-flowering varieties. Remove the oldest, dark-brown canes so new canes can replace old canes.

PRUNING SPECIES, SHRUB AND ONCE-BLOOMING ROSES

Gallicas, hybrid musks and species such as *Rosa rugosa* flower once a year. These roses need light annual pruning to maintain symmetry and remove dead and diseased canes. Remove flowers of repeat-flowering kinds. Leave flowers of once-blooming kinds so attractive hips can develop.

Old roses such as albas, centifolias, moss and damask roses produce flowers on laterals of old wood. Shorten long shoots during the dormant season. Shorten last-season's most vigorous growth by 1/3. Cut back laterals to about 6 inches long or three buds each. Cutting back harder destroys the arching habit.

Hybrid perpetual, China and bourbon roses are vigorous growers. These roses easily become a tangled mass of new laterals and sublaterals. Remove faded flowers and lightly thin dense growth. Interior twiggy growth should be removed during dormant season.

Shrub roses and once-blooming climbers include yellow and white *Rosa banksiae,* 'Belle of Portugal' and 'Mermaid'. Give these roses plenty of room to grow. Little pruning is required. Prune these roses to shape when young. When roses are mature, remove twiggy growth and old canes. In general, most of these species need little pruning. Prune old garden roses by

'Harison's Yellow', shrub rose.

removing old canes. Shorten other canes by about 1/3. These roses create more flowers if canes are arched and pegged to the ground.

PRUNING RAMBLERS

Ramblers flower in midsummer on laterals of long, flexible basal shoots that grew the previous season. Few true ramblers remain except in areas where they thrive—Nantucket, Cape Cod and the Oregon and Washington coasts. These areas usually feature at least two or three naturalized rambling roses. 'American Pillar' is the rambler often found in old gardens. 'Chevy Chase', 'Dorothy Perkins', 'Thousand Beauties' and 'Crimson Rambler' are other well-known rambling roses.

Hard winter pruning of ramblers encourages vigorous growth next summer. Hard pruning also reduces the number of flowers until the second summer. Ramblers are usually not pruned and simply become a thorny thicket. To prune ramblers for containment and appearance, remove all flowering canes to the ground immediately after flowering.

'Evangeline' rambler. This older type of rose was planted years ago. Each spring, the rosebush is covered with beautiful blooms. Ramblers are excellent for covering old buildings and trees.

PRUNING TREE ROSES

Varieties of hybrid tea, grandiflora and occasionally floribunda are grafted to trunks of selected varieties of wild, climbing roses that produce stiff trunks. Always remove any growth from tree-rose trunks below the upper bud union. Principles of pruning are the same as for respective types of roses, but tree roses are at eye level. An attractive, well-balanced tree structure is important. Lightly pruned tree roses are susceptible to toppling in strong wind. Heavy pruning is advised, depending on the variety.

Tree roses do not renew themselves with new basal canes. Canes should not be removed down to the bud union. Cut back hybrid-tea and grandiflora canes each year. Leave one or two buds from the previous season. Leave *four* to six buds on floribunda canes.

Remember the growth-direction effect of pruning. Cut to outside-facing buds to develop an attractively shaped head.

Check support stakes to make sure they are in good condition and do not rub or chafe plants.

Different varieties of tree roses produce different shaped trees. 'Bewitched' and 'Queen Elizabeth' produce tall, vigorous upright-growing standards. They are two of the largest tree roses, almost the size of small specimen trees. 'King's Ransom', 'Mister Lincoln' and 'Chrysler Imperial' are vigorous and upright, but not quite as tall.

'Peace', 'Chicago Peace' and 'Tropicana' are tall and vigorous. These varieties produce spreading, rounded trees.

'Pink Peace', 'Electron' and 'Double Delight' are hybrid teas that produce dense, bushy flowering heads.

Popular grandifloras for tree roses are 'Ole', 'Pink Parfait' and 'Prominent'. These tree roses make small, dense heads that produce many flowers.

Low-growing floribundas make excellent tree roses or 2-foot-high patio standards. 'Sarabande' is compact and attractive. Others varieties are 'Angel Face', 'Cherish', 'Charisma' and 'Europeana'.

Right: This European tree rose, 'Shreveport', makes an excellent display specimen.

'Renae', a climbing floribunda, makes a good tree rose when grafted to a trunkstock.